

CONTRACT DOCUMENTS AND SPECIFICATIONS
FOR
ROADWAY, WATER, AND WASTEWATER IMPROVEMENTS
AT
CLARENDON COUNTY INDUSTRIAL PARK
IN
UNINCORPORATED
CLARENDON COUNTY, SOUTH CAROLINA
FOR
CLARENDON COUNTY



ALLIANCE CONSULTING ENGINEERS, INC.
PROJECT NO. 22201-0014
BID NO. CCP2024100ACE

MAY 2023

BID DOCUMENTS

CONTRACTOR:

ADDRESS:

CONTRACTOR'S LICENSE NUMBER:



Alliance Consulting Engineers, Inc.
Post Office Box 8147
Columbia, SC 29202-8147
(803) 779-2078 • (803) 779-2079 fax
www.allianceCE.com

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ADVERTISEMENT FOR BIDS

Owner: Clarendon County

Alliance Consulting Engineers, Inc. Project No.: 22201-0014

Separate sealed bids (Bid Number 2022-IFB-27) for construction of the **Roadway, Water, and Wastewater Improvements at the Clarendon County Industrial Park** will be received until **2:00 PM** on **Tuesday, April 9th, 2024**, and then publicly opened and read aloud. Bids will be accepted in person. The bid will be located at 411 Sunset Drive, Manning, SC 29102. The work to be completed as a part of this project consists of providing all required materials, equipment and labor necessary to complete. The deadline for submitting questions is **5:00 PM** on **Thursday, March 28, 2024**.

Base Bid –Proposed Improvements include work associated with the proposed extension of Jo Rogers Jr Blvd., the proposed water main extension, the proposed wastewater gravity main to serve Buildings No 8 & 9, the proposed wastewater force main, and the proposed 180 GPM pump station.

The Instructions to Bidders, Bid Form, Contract, Plans, Specifications, Bid Bond, Performance Bond, Payment Bond, and other contract documents may be examined at the following locations:

Owner: Clarendon County
Tripp Duke, PMP, Procurement Director
411 Sunset Drive
Manning, South Carolina, 29102

Engineers: Alliance Consulting Engineers, Inc., 1201 Main Street, Suite 2020, Columbia, SC 29201

Drawings, specifications, and contract documents may be obtained from the office of Alliance Consulting Engineers, Inc., Post Office Box 8147, Columbia, SC 29202-8147 upon a **non-refundable payment of \$150**. When requesting drawings, specifications, or contract documents, provide the following information about your company: Mailing address; street (UPS) address; telephone number, email and FAX number (if applicable).

Bidders must deposit security with all bids. Security shall be in the form of a certified check or bid bond made payable to the Owner, and shall be for an amount equal to not less than five percent (5%) of the amount of the bid. Provisions of the security shall be as described in the Information for Bidders. No bid will be considered unless the bidder is legally qualified under the provisions of the South Carolina Sections 40-11-10 through 40-11-428).

NOTICE TO BIDDERS:

This project is being funded in part by the South Carolina Rural Infrastructure Authority (RIA) Economic Infrastructure Program.

BIDS WILL NOT BE CONSIDERED FROM ANY VENDOR THAT OWES DELINQUENT BUSINESS PROPERTY TAXES TO CLARENDON COUNTY.

NOTICE TO BIDDERS: Each bidder shall fully acquaint themselves with the conditions relating to the scope and restrictions attending the execution of the work under the conditions of this Bid. The failure or omission of a bidder to acquaint themselves with existing conditions shall in no way relieve them of any obligation with respect to this Bid or to the contract. All amendments to and interpretations of this solicitation shall be in writing and issued by Alliance Consulting Engineers, Inc. Clarendon County or Alliance Consulting Engineers, Inc. shall not be legally bound by any amendment or interpretation that is not in writing. **Award of the project is contingent on funding approval by the Clarendon County Council and will be based on the total cost of the base bid.**

No bidder may withdraw the bid within sixty (60) days after the actual date of the opening and thereof.

The Owner reserves the right to waive any informality or to reject any or all bids.

ENGINEERS

Alliance Consulting Engineers, Inc.
Post Office Box 8147
Columbia, South Carolina 29202-8147

OWNER

Clarendon County
411 Sunset Drive
Manning, South Carolina 29102

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INSTRUCTIONS TO BIDDERS

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ARTICLE 1 - DEFINED TERMS

- 1.01 Terms used in these Instructions to Bidders have the meanings indicated in the General Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below:
- A. **Issuing Office**-The office from which the Bidding Documents are to be issued and where the bidding procedures are to be administered.

ARTICLE 2 - COPIES OF BIDDING DOCUMENTS

- 2.01 Complete sets of the Bidding Documents in the number and for the deposit sum, if any, stated in the Advertisement or Invitation to Bid may be obtained from Alliance Consulting Engineers, Inc., P.O. Box 8147, Columbia, SC 29202-8147. The deposit will be nonrefundable and a FedEx account number must be provided for FedEx delivery of Plan Sets.
- 2.02 Complete sets of Bidding Documents shall be used in preparing Bids; neither Owner nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.
- 2.03 Owner and Engineer, in making copies of Bidding Documents available on the above terms, do so only for the purpose of obtaining Bids for the Work and do not confer a license or grant for any other use.
- 2.04

ARTICLE 3 - QUALIFICATIONS OF BIDDERS

- 3.01 To demonstrate Bidder's qualifications to perform the Work, within five (5) days of Owner's request, Bidder shall submit written evidence such as financial data; previous experience, present commitments.

ARTICLE 4 - EXAMINATION OF BIDDING DOCUMENTS, OTHER RELATED DATA, AND SITE

- 4.01 Subsurface and Physical Conditions
- A. Subsurface Evaluation Report:
1. Report of Subsurface Exploration Entrance Road to Clarendon County Industrial Park – Roadway – Prepared for the Project by S&ME, Inc. dated February 1, 2023 (S&ME, Inc. Project No.: 218770)
 2. Report of Subsurface Exploration Entrance Road to Clarendon County Industrial Park – Pump Station – Prepared for the Project by S&ME, Inc. dated February 1, 2023 (S&ME, Inc. Project No.: 218770)
 - a. A copy of these reports are included in this Section 02 30 00.

- 4.02 Underground Facilities
- A. Information and data shown or indicated in the Bidding Documents with respect to existing Underground Facilities at or contiguous to the Site is based upon information and data furnished to Owner and Engineer by owners of such Underground Facilities, including Owner, or others.
- 4.03 Hazardous Environmental Condition
- A. The General Conditions identify those reports and drawings relating to a Hazardous Environmental Condition identified at the Site, if any, that Engineer has used in preparing the Bidding Documents.
- B. Copies of reports and drawings referenced in Paragraph 4.03.A are included herein. Those reports and drawings are not part of the Contract Documents, but the “technical data” contained therein upon which Bidder is entitled to rely as provided in Paragraph 4.06 of the General Conditions has been identified and established. Bidder is responsible for any interpretation or conclusion Bidder draws from any “technical data” or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.
- 4.04 Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to subsurface conditions, other physical conditions and Underground Facilities, and possible changes in the Bidding Documents due to differing or unanticipated conditions appear in Paragraphs 4.02, 4.03, and 4.04 of the General Conditions. Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to a Hazardous Environmental Condition at the Site, if any, and possible changes in the Contract Documents due to any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work appear in Paragraph 4.06 of the General Conditions.
- 4.05 On request, Owner will provide Bidder access to the Site to conduct such examinations, investigations, explorations, tests, and studies as Bidder deems necessary for submission of a Bid. Bidder shall fill all holes and clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies. Bidder shall comply with all applicable Laws and Regulations relative to excavation and utility locates. Engineer and Owner shall be notified prior to any site visits.
- 4.06 Reference is made to Article 7 of the General Conditions for the identification of the general nature of other work that is to be performed at the Site by Owner or others (such as utilities and other prime contractors) that relates to the Work contemplated by these Bidding Documents. On request, Owner will provide to each Bidder for examination access to or copies of Contract Documents (other than portions thereof related to price) for such other work.
- 4.07 It is the responsibility of each Bidder before submitting a Bid to:
- A. Examine and carefully study the Bidding Documents, the other related data identified in the Bidding Documents, and any Addenda.
- B. Visit the Site and become familiar with and satisfy Bidder as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
- C. Become familiar with and satisfy Bidder as to all federal, state, and local Laws and Regulations that may affect cost, progress, and performance of the Work.

- D. Carefully study all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities), which have been identified in Paragraph 4.02 of the General Conditions, and (2) reports and drawings of Hazardous Environmental Conditions at the Site which have been identified in Paragraph 4.06 of the General Conditions.
 - E. Obtain and carefully study (or accept consequences of not doing so) all additional or supplementary examinations, investigations, explorations, tests, studies, and data concerning conditions (surface, subsurface, and Underground Facilities) at or contiguous to the Site, which may affect cost, progress, or performance of the Work or which relate to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including applying any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents, and safety precautions and programs incident thereto.
 - F. Agree at the time of submitting its Bid that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of its Bid for performance of the Work at the price(s) bid and within the times and in accordance with the other terms and conditions of the Bidding Documents.
 - G. Become aware of the general nature of the work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.
 - H. Correlate the information known to Bidder, information and observations obtained from visits to the Site, reports and drawings identified in the Bidding Documents, and all additional examinations, investigations, explorations, tests, studies, and data with the Bidding Documents.
 - I. Promptly give Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder discovers in the Bidding Documents and confirm that the written resolution thereof by Engineer is acceptable to Bidder.
 - J. Determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work.
- 4.08 The submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article 4, that without exception the Bid is premised upon performing and furnishing the Work required by the Bidding Documents and applying any specific means, methods, techniques, sequences, and procedures of construction that may be shown or indicated or expressly required by the Bidding Documents, that Bidder has given Engineer written notice of all conflicts, errors, ambiguities, and discrepancies that Bidder has discovered in the Bidding Documents and the written resolutions thereof by Engineer are acceptable to Bidder, and that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performing and furnishing the Work.

ARTICLE 5 - SITE AND OTHER AREAS

- 5.01 The Site is identified in the Bidding Documents. Easements for permanent structures or permanent changes in existing facilities are to be obtained and paid for by Owner unless otherwise provided in the Bidding Documents. All additional land and access thereto required for temporary construction facilities, construction equipment, or storage of materials and equipment to be incorporated in the Work are to be obtained and paid for by Contractor.

ARTICLE 6 - INTERPRETATIONS AND ADDENDA

- 6.01 All questions about the meaning or intent of the Bidding Documents are to be submitted to Engineer in writing (vburbage@alliancece.com or 803-779-2078). Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda mailed or delivered to all parties recorded by Engineer as having received the Bidding Documents. Questions received less than seven (7) days prior to the date for opening of Bids may not be answered. Only questions answered by Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.
- 6.02 Addenda may be issued to clarify, correct, or change the Bidding Documents as deemed advisable by Owner or Engineer.

ARTICLE 7 - BID SECURITY

- 7.01 A Bid must be accompanied by Bid security made payable to Owner in an amount of five percent (5%) of Bidder's maximum Bid price and in the form of a certified check, bank money order, or a Bid Bond (on the form attached) issued by a surety meeting the requirements of Paragraphs 5.01 and 5.02 of the General Conditions.
- 7.02 The Bid security of the Successful Bidder will be retained until such Bidder has executed the Contract Documents, furnished the required contract security and met the other conditions of the Notice of Award, whereupon the Bid security will be returned. If the Successful Bidder fails to execute and deliver the Contract Documents and furnish the required contract security within fifteen (15) days after the Notice of Award, Owner may annul the Notice of Award and the Bid security of that Bidder will be forfeited. The Bid security of other Bidders whom Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of seven (7) days after the Effective Date of the Agreement or sixty (60) days after the Bid opening, whereupon Bid security furnished by such Bidders will be returned.
- 7.03 Bid security of other Bidders whom Owner believes do not have a reasonable chance of receiving the award will be returned within fourteen (14) days after the Bid opening.

ARTICLE 8 - CONTRACT TIMES

- 8.01 The time allotted for completion of the Roadway, Water, and Wastewater Improvements at the Clarendon County Industrial Park, including alternate(s) approved by the Owner and the Engineer is as follows:

Substantial Completion 180 calendar days after the Notice to Proceed has been issued.

ARTICLE 9 - LIQUIDATED DAMAGES

- 9.01 Document Execution
- A. The successful Bidder, upon failure or refusal to execute and deliver the contract and bonds within ten (10) days after they have received the notice of the acceptance of their bid, shall forfeit to the Owner, as liquidated damages, the security deposited with the bid.
- 9.02 Project Execution
- A. Bidder must agree to commence work on or before a date to be specified in a written "Notice to Proceed" of the Owner and to fully complete the project within the dates specified in the Bid Form, Article 6; Paragraph 6.01. Bidder must agree also to pay as liquidated damages the sum

as indicated in the Bid Form, Article 6; Paragraph 6.02 for each consecutive calendar day thereafter as hereinafter provided in the General Conditions.

ARTICLE 10 - SUBSTITUTE AND "OR-EQUAL" ITEMS

- 10.01 The Contract, if awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents without consideration of possible substitute or "or-equal" items. Whenever it is specified or described in the Bidding Documents that a substitute or "or-equal" item of material or equipment may be furnished or used by Contractor if acceptable to Engineer, application for such acceptance will not be considered by Engineer until after the Effective Date of the Agreement.

ARTICLE 11 - SUBCONTRACTORS, SUPPLIERS, AND OTHERS

- 11.01 If the General Conditions require the identity of certain Subcontractors, Suppliers, individuals, or entities to be submitted to Owner in advance of a specified date prior to the Effective Date of the Agreement, the apparent Successful Bidder, and any other Bidder so requested, shall within five (5) days after Bid opening, submit to Owner a list of all such Subcontractors, Suppliers, individuals, or entities proposed for those portions of the Work for which such identification is required. Such list shall be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor, Supplier, individual, or entity if requested by Owner. If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor, Supplier, individual, or entity, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit a substitute, in which case apparent Successful Bidder shall submit an acceptable substitute, Bidder's Bid price will be increased (or decreased) by the difference in cost occasioned by such substitution, and Owner may consider such price adjustment in evaluating Bids and making the Contract award.
- 11.02 If apparent Successful Bidder declines to make any such substitution, Owner may award the Contract to the next lowest Bidder that proposes to use acceptable Subcontractors, Suppliers, individuals, or entities. Declining to make requested substitutions will not constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor, Supplier, individual, or entity so listed and against which Owner or Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to revocation of such acceptance after the Effective Date of the Agreement as provided in Paragraph 6.06 of the General Conditions.
- 11.03 Contractor shall not be required to employ any Subcontractor, Supplier, individual, or entity against whom Contractor has reasonable objection.

ARTICLE 12 - PREPARATION OF BID

- 12.01 The Bid Form is included with the Bidding Documents. Additional copies may be obtained from Engineer.
- 12.02 All blanks on the Bid Form shall be completed by printing in ink or by typewriter and the Bid signed in ink. Erasures or alterations shall be initialed in ink by the person signing the Bid Form. A Bid price shall be indicated for each unit price item listed therein, or the words "No Bid," "No Change," or "Not Applicable" entered.

- 12.03 A Bid by a corporation shall be executed in the corporate name by the president, vice-president, or other corporate officer accompanied by evidence of authority to sign. The corporate seal shall be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation shall be shown below the signature.
- 12.04 A Bid by a partnership shall be executed in the partnership name and signed by a partner (whose title must appear under the signature), accompanied by evidence of authority to sign. The official address of the partnership shall be shown below the signature.
- 12.05 A Bid by a limited liability company shall be executed in the name of the firm by a member and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm shall be shown below the signature.
- 12.06 A Bid by an individual shall show the Bidder's name and official address.
- 12.07 A Bid by a joint venture shall be executed by each joint venturer in the manner indicated on the Bid Form. The official address of the joint venture shall be shown below the signature.
- 12.08 All names shall be typed or printed in ink below the signatures.
- 12.09 The Bid shall contain an acknowledgment of receipt of all Addenda, the numbers of which shall be filled in on the Bid Form.
- 12.10 The address and telephone number for communications regarding the Bid shall be shown.
- 12.11 The Bid shall contain evidence of Bidder's authority and qualification to do business in the state where the Project is located or covenant to obtain such qualification prior to award of the Contract. Bidder's state contractor license number, if any, shall also be shown on the Bid Form.

ARTICLE 13 - BASIS OF BID; COMPARISON OF BIDS

- 13.01 Unit Price
- A. Bidders shall submit a Bid on a unit price basis for each item of Work listed in the Bid schedule.
- B. The total of all estimated prices will be the sum of the products of the estimated quantity of each item and the corresponding unit price. The final quantities and Contract Price will be determined in accordance with Paragraph 11.03 of the General Conditions.
- C. Discrepancies between the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum. Discrepancies between words and figures will be resolved in favor of the words.
- 13.02 The Bid price shall include such amounts as the Bidder deems proper for overhead and profit on account of cash allowances, if any, named in the Contract Documents as provided in Paragraph 11.02 of the General Conditions.

13.03 Deleted

ARTICLE 14 - SUBMITTAL OF BID

- 14.01 With each copy of the Bidding Documents, a Bidder is furnished one (1) separate unbound copy of the Bid Form, and, if required, the Bid Bond Form. The unbound copy of the Bid Form is to be completed and submitted with the Bid security and the following data:
- A. Power of Attorney.

- 14.02 A Bid shall be submitted no later than the date and time prescribed in the Advertisement for Bid. Bids will **NOT** be accepted in any other manner.

ARTICLE 15 - MODIFICATION OF BID

- 15.01 A Bid may be modified or withdrawn by an appropriate document duly executed in the manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time for the opening of Bids.

ARTICLE 16 - OPENING OF BIDS

- 16.01 Bids will be opened at the time and place indicated in the Advertisement or Invitation to Bid and, unless obviously non-responsive, read aloud publicly. An abstract of the amounts of the base Bids and major alternates, if any, will be made available to Bidders after the opening of Bids in the form of a Bid Tabulation and Bid Comparison. The Bid Opening Minutes will also be provided to all in attendance.

ARTICLE 17 - BIDS TO REMAIN SUBJECT TO ACCEPTANCE

- 17.01 All Bids will remain subject to acceptance for the period of time stated in the Bid Form, but Owner may, in its sole discretion, release any Bid and return the Bid security prior to the end of this period.

ARTICLE 18 - EVALUATION OF BIDS AND AWARD OF CONTRACT

- 18.01 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, non-responsive, unbalanced, or conditional Bids. Owner further reserves the right to reject the Bid of any Bidder whom it finds, after reasonable inquiry and evaluation, to not be responsible. Owner may also reject the Bid of any Bidder if Owner believes that it would not be in the best interest of the Project to make an award to that Bidder. Owner also reserves the right to waive all informalities not involving price, time, or changes in the Work and to negotiate contract terms with the Successful Bidder.

- 18.02 More than one Bid for the same Work from an individual or entity under the same or different names will not be considered. Reasonable grounds for believing that any Bidder has an interest in more than one Bid for the Work may be cause for disqualification of that Bidder and the rejection of all Bids in which that Bidder has an interest.
- 18.03 In evaluating Bids, Owner will consider whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices and other data, as may be requested in the Bid Form or prior to the Notice of Award.
- 18.04 In evaluating Bidders, Owner will consider the qualifications of Bidders and may consider the qualifications and experience of Subcontractors, Suppliers, and other individuals or entities proposed for those portions of the Work for which the identity of Subcontractors, Suppliers, and other individuals or entities must be submitted as provided in the General Conditions.
- 18.05 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders, proposed Subcontractors, Suppliers, individuals, or entities to perform the Work in accordance with the Contract Documents.
- 18.06 If the Contract is to be awarded, Owner will award the Contract to the Bidder whose Bid is in the best interests of the Project.
- 18.07 The Owner reserves the right not to Award the Project.

ARTICLE 19 - CONTRACT SECURITY AND INSURANCE

- 19.01 Article 5 of the General Conditions sets forth Owner's requirements as to performance and payment bonds and insurance. When the Successful Bidder delivers the executed Agreement to Owner, it shall be accompanied by such bonds.

ARTICLE 20 - SIGNING OF AGREEMENT

- 20.01 When Owner gives a Notice of Award to the Successful Bidder, it shall be accompanied by the required number of unsigned counterparts of the Agreement with the other Contract Documents which are identified in the Agreement as attached thereto. Within seven (7) days thereafter, Successful Bidder shall sign and deliver the required number of counterparts of the Agreement and attached documents to Owner. Within seven (7) days thereafter, Owner shall deliver one (1) fully signed counterpart to Successful Bidder with a complete set of the Drawings with appropriate identification.

ARTICLE 21 - RETAINAGE

- 21.01 Retainage from progress payments to the Contractor shall be ten percent (10%) of each payment for work completed and stored materials on site.

END OF SECTION

**SECTION 00 41 00
BID FORM**

**ROADWAY, WATER, AND WASTEWATER IMPROVEMENTS
AT THE
CLARENDON COUNTY INDUSTRIAL PARK
FOR
CLARENDON COUNTY**

TABLE OF ARTICLES

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ARTICLE 1 - BID RECIPIENT

- 1.01 This Bid is submitted to the office of Clarendon County at 411 Sunset Drive, Manning, SC, 29102.
- 1.02 Deleted
- 1.03 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2 - BIDDER'S ACKNOWLEDGEMENTS

- 2.01 Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for sixty (60) days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

ARTICLE 3 - BIDDER'S REPRESENTATIONS

- 3.01 In submitting this Bid, Bidder represents that:

- A. Bidder has examined and carefully studied the Bidding Documents, the other related data identified in the Bidding Documents, and the following Addenda, receipt of which is hereby acknowledged.

<u>Addendum No.</u>	<u>Addendum Date</u>	<u>Initials</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____

- B. Bidder has visited the Site and become familiar with and is satisfied as to the general, local and Site conditions that may affect cost, progress, and performance of the Work.
- C. Bidder is familiar with and is satisfied as to all federal, state and local Laws and Regulations that may affect cost, progress and performance of the Work.
- D. Bidder has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities), which have been identified in Paragraph 4.02 of General Conditions, and (2) reports and drawings of Hazardous Environmental Conditions that have been identified in Paragraph 4.06 of General Conditions.
- E. Bidder has obtained and carefully studied (or accepts the consequences for not doing so) all additional or supplementary examinations, investigations, explorations, tests, studies and data concerning conditions (surface, subsurface and Underground Facilities) at or contiguous to the Site, which may affect cost, progress, or performance of the Work or which relate to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including applying the specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents to be employed by Bidder, and safety precautions and programs incident thereto.

- F. Bidder does not consider that any further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price(s) bid and within the times and in accordance with the other terms and conditions of the Bidding Documents.
- G. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.
- H. Bidder has correlated the information known to Bidder, information and observations obtained from visits to the Site, reports and drawings identified in the Bidding Documents, and all additional examinations, investigations, explorations, tests, studies, and data with the Bidding Documents.
- I. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and the written resolution thereof by Engineer is acceptable to Bidder.
- J. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work for which this Bid is submitted.
- K. Bidder will submit written evidence of its authority to do business in the state where the Project is located not later than the date of its execution of the Agreement.

ARTICLE 4 - FURTHER REPRESENTATIONS

4.01 Bidder further represents that:

- A. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any agreement or rules of any group, association, organization or corporation.
- B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid.
- C. Bidder has not solicited or induced any individual or entity to refrain from bidding.
- D. Bidder has not sought by collusion to obtain for itself any advantage over any other Bidder or over Owner.

ARTICLE 5 – BASIS OF BID

Base Bid

5.01 Bidder will complete the Work in accordance with the Contract Documents for the following unit price(s):

Roadway, Water, and Wastewater Improvements at the Clarendon County Industrial Park					
<u>Item No.</u>	<u>Description</u>	<u>Unit</u>	<u>Estimated Quantity</u>	<u>Unit Price</u>	<u>Bid Price</u>
1	Mobilization/Bonds	LS	1	\$	\$
2	Construction Entrance	EA	1	\$	\$
3	Silt Fence	LF	4,500	\$	\$
4	Concrete Washout	EA	1	\$	\$
5	Rip-Rap Check Dam	EA	13	\$	\$
6	Rip-Rap Outlet Protection	SY	60	\$	\$
7	SC150 Erosions Control Matting	SY	4,000	\$	\$
8	Clearing and Grubbing (Area within Limits of	AC	9	\$	\$

	Disturbance)				
9	Temporary Grassing	AC	5	\$	\$
10	Earthwork (Excavation/Haul/Backfill/Compaction of Select Fill Import)	LS	1	\$	\$
11	15-inch RCP	LF	50	\$	\$
12	48-inch RCP	LF	100	\$	\$
13	Flared End Section	EA	4	\$	\$
14	16-inch C900 DR18 PVC Watermain (w/ Appurtenances)	LF	1,505	\$	\$
15	2-inch PVC Watermain (w/ Appurtenances)	LF	10	\$	\$
16	Fire Hydrant Assembly	EA	1	\$	\$
17	16-inch Gate Valve and Valve Box	EA	2	\$	\$
18	16-inch Water Main End Cap	EA	1	\$	\$
19	Connection to Existing Water Main (Includes Tapping Sleeve)	EA	1	\$	\$
20	Graded Aggregate Base 6-inch	SY	350	\$	\$
21	Fencing	LS	1	\$	\$
22	Fence Gate	EA	1	\$	\$
23	Pump Station (180 GPM)	LS	1	\$	\$
24	6-inch PVC Gravity Wastewater Line	LF	1,000	\$	\$
25	6-inch PVC Force Main Wastewater Line	LF	2,700	\$	\$
26	Connection to Existing Wastewater Manholes	EA	2	\$	\$
27	Air Release Valve	EA	1	\$	\$
28	Wastewater Manhole (0-6 feet)	EA	1	\$	\$
29	Wastewater Manhole (6-8 feet)	EA	1	\$	\$
30	Wastewater Manhole (8-10 feet)	EA	2	\$	\$
31	1.5-inch Asphalt Surface Course (Type B)	SY	7,000	\$	\$
32	3.25-inch Asphalt Binder Course (Type B)	SY	7,000	\$	\$
33	8-inch Graded Aggregate Base Course	SY	7,000	\$	\$
34	2-inch Asphalt Milling	SY	40	\$	\$
35	2-inch Asphalt Overlay (Type B)	SY	40	\$	\$
36	Tack Coat for Overlay Pavement	SY	40	\$	\$
37	Demolition of Existing Turnaround	LS	1	\$	\$
38	Striping and Signage Allowance	LS	1	\$	\$

Total Base Bid: \$ _____

The above unit prices shall include all labor, materials, bailing, shoring, removal, overhead, profit, insurance, etc., to complete the finish work as stipulated in the Bid Documents.

Unit Prices have been computed in accordance with Paragraph 11.03.B of the General Conditions.

Bidder acknowledges that estimated quantities are not guaranteed, and are solely for the purpose of comparison of Bids, and final payment for all Unit Price Bid items will be based on actual quantities, determined as provided in the Contract Documents.

ARTICLE 6 - TIME OF COMPLETION

6.01 **Bidder agrees that the Work: Roadway, Water, and Wastewater Improvements at the Clarendon County Industrial Park in Clarendon County, South Carolina is to be completed within one hundred eighty (180) calendar days for the Base Bid scope of work after the Notice to Proceed has been issued.**

6.02 Bidder accepts the provisions of the Agreement as to liquidate damages in the event of failure to complete the Work within the Contract dates in the amount of \$1,500 per day for each calendar day required to complete the work in the manner and within the dates as stated in Paragraph 6.01 above.

ARTICLE 7 - ATTACHMENTS TO THIS BID

7.01 The following documents are attached to and made a condition of this Bid:

- A. Required Bid security in the form of five percent (5%) of the total bid amount.
- B. Power of Attorney.

ARTICLE 8 - DEFINED TERMS

8.01 The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders and General Conditions.

**SECTION 00 43 00
BID BOND**

Any singular reference to Bidder, Surety, Owner, or other party shall be considered plural where applicable.

BIDDER (Name and Address):

SURETY (Name and Address of Principal Place of Business):

OWNER (Name and Address): **Clarendon County
411 Sunset Drive
Manning, South Carolina, 29102**

BID

Bid Due Date: _____

Project (Brief Description Including Location): **Roadway, Water, and Wastewater Improvements at
the Clarendon County Industrial Park**

BOND

Bond Number:

Date (Not later than Bid due date):

Penal sum _____ (Words) _____ (Figures)

Surety and Bidder, intending to be legally bound hereby, subject to the terms printed on the reverse side hereof, do each cause this Bid Bond to be duly executed on its behalf by its authorized officer, agent, or representative.

BIDDER

SURETY

(Seal)
Bidder's Name and Corporate Seal

(Seal)
Surety's Name and Corporate Seal

By: _____
Signature and Title

By: _____
Signature and Title
(Attach Power of Attorney)

Attest: _____
Signature and Title

Attest: _____
Signature and Title

Note: Above addresses are to be used for giving required notice.

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Surety's liability.
2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.
3. This obligation shall be null and void if:
 - 3.1. Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or
 - 3.2. All Bids are rejected by Owner, or
 - 3.3. Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).
4. Payment under this Bond will be due and payable upon default by Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.
5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed 120 days from Bid due date without Surety's written consent.
6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4
7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.
8. Notices required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.
9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.
10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.
11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

above is received by Bidder and Surety and in no case later than one year after Bid due date.

SECTION 00 45 13

CONTRACTOR/SUBCONTRACTOR QUALIFICATIONS

PART 1 - GENERAL

1.01 The following information and completed forms may be requested by the Owner of the three (3) lowest bidders. The request will be made the day of the Bid Opening or within five (5) days following the Bid Opening. If requested, this data must be submitted to the Engineer or Owner within five (5) days of the request. Failure to provide the data in this section, upon request, will subject bidder to disqualification.

1.02 DESCRIPTION

- A. Information provided will be used by the Engineer or Owner to determine the competency and ability of the Contractor and/or Subcontractor to perform the scheduled work in a manner that is satisfactory to the Engineer or Owner. The Engineer or Owner's decision shall be final.
- B. Any Subcontractor being used by the General Contractor, whose portion of the project exceeds 5% of the total bid price amount, will be required to provide the same information as the General Contractor.
- C. The Contractor and Subcontractor shall include with this section a detailed financial statement indicating the Contractor's or Subcontractor's financial resources. The information on that statement shall be certified by a Certified Public Accountant and shall be submitted on the Associated General Contractor's of America form "Standard Questionnaires and Financial Statement for Bidders".
- D. The Contractor and Subcontractor shall certify by attaching their signature to this Section as provided that all information contained herein is complete and all statements and answers are accurate and true. Providing misinformation, incomplete information, inaccurate information, or failure to certify the information, will subject bidder to disqualification.

1.03 QUALIFICATIONS

- A. Complete the following for General Contractor and any Subcontractors (attach additional sheets as required):
 - 1. Name: _____
 - 2. Address: _____
 - 3. City, State, Zip: _____
 - 4. Principle: _____
- B. Number of years the company has been in business: _____
- C. List and describe at least five (5) projects that have been completed, that are similar in size and type, and that has been completed within the last ten (10) years:
 - 1. _____

 - 2. _____

- 3. _____

- 4. _____

- 5. _____

D. For the projects listed above provide the following:

- 1. Project Owner: _____
 Contact Name and Title: _____
 Telephone Number: _____
- 2. Project Owner: _____
 Contact Name and Title: _____
 Telephone Number: _____
- 3. Project Owner: _____
 Contact Name and Title: _____
 Telephone Number: _____
- 4. Project Owner: _____
 Contact Name and Title: _____
 Telephone Number: _____
- 5. Project Owner: _____
 Contact Name and Title: _____
 Telephone Number: _____

E. For each of the projects listed in Items C & D provide the following:

- 1. Original Bid Amount: _____
 Final Construction Cost: _____
 Contract Period: _____
 Actual Contract Period: _____
 Explanation: _____

2. Original Bid Amount: _____
 Final Construction Cost: _____
 Contract Period: _____
 Actual Contract Period: _____
 Explanation: _____

3. Original Bid Amount: _____
 Final Construction Cost: _____
 Contract Period: _____
 Actual Contract Period: _____
 Explanation: _____

4. Original Bid Amount: _____
 Final Construction Cost: _____
 Contract Period: _____
 Actual Contract Period: _____
 Explanation: _____

5. Original Bid Amount: _____
 Final Construction Cost: _____
 Contract Period: _____
 Actual Contract Period: _____
 Explanation: _____

F. Provide the following for any portion of the work that is being subcontracted (5% or more of the Bid Amount):

1. Name of Subcontractor: _____
 Address: _____
 Telephone Number: _____
 Work being Completed: _____

2. Name of Subcontractor: _____
 Address City/State/Zip: _____
 Telephone Number: _____
 Work being Completed: _____

- 3. Name of Subcontractor: _____
 Address City/State/Zip: _____
 Telephone Number: _____
 Work being Completed: _____

- 4. Name of Subcontractor: _____
 Address City/State/Zip: _____
 Telephone Number: _____
 Work being Completed: _____

- 5. Name of Subcontractor: _____
 Address City/State/Zip: _____
 Telephone Number: _____
 Work being Completed: _____

G. Provide a list of equipment that is owned by the Contractor and is available for this project.

H. Provide a list of equipment that will be purchased, leased or rented for this project.

I. Provide a list of the superintendent(s) or others that will be in charge of this project (Provide resumes and qualifications):

J. Provide the following for current projects being completed:

- 1. Project Name: _____
 Owner: _____
 Current Status: _____
 Estimated Schedule of Completion: _____

- 2. Project Name: _____
 Owner: _____
 Current Status: _____
 Estimated Schedule of Completion: _____

3. Project Name: _____
 Owner: _____
 Current Status: _____
 Estimated Schedule of Completion: _____

4. Project Name: _____
 Owner: _____
 Current Status: _____
 Estimated Schedule of Completion: _____

5. Project Name: _____
 Owner: _____
 Current Status: _____
 Estimated Schedule of Completion: _____

K. Provide a list of projects that has been completed with the Owner over the past fifteen (15) years:

1. Project Name: _____
 Contact Name and Title: _____
 Telephone Number: _____

2. Project Name: _____
 Contact Name and Title: _____
 Telephone Number: _____

3. Project Name: _____
 Contact Name and Title: _____
 Telephone Number: _____

4. Project Name: _____
 Contact Name and Title: _____
 Telephone Number: _____

5. Project Name: _____
 Contact Name and Title: _____
 Telephone Number: _____

L. Provide a list of projects that Bid with the Owner over the past fifteen (15) years:

1. Project Name: _____
Contact Name and Title: _____
Telephone Number: _____

2. Project Name: _____
Contact Name and Title: _____
Telephone Number: _____

3. Project Name: _____
Contact Name and Title: _____
Telephone Number: _____

4. Project Name: _____
Contact Name and Title: _____
Telephone Number: _____

5. Project Name: _____
Contact Name and Title: _____
Telephone Number: _____

M. Provide a list of projects completed with the Engineer over the past fifteen (15) years:

1. Project Name: _____
Project Engineer: _____
Original Bid Amount: _____
Final Construction Cost: _____
Contract Period: _____
Actual Contract Period: _____
Explanation: _____

2. Project Name: _____
Project Engineer: _____
Original Bid Amount: _____
Final Construction Cost: _____
Contract Period: _____
Actual Contract Period: _____
Explanation: _____

3. Project Name: _____
 Project Engineer: _____
 Original Bid Amount: _____
 Final Construction Cost: _____
 Contract Period: _____
 Actual Contract Period: _____
 Explanation: _____

4. Project Name: _____
 Project Engineer: _____
 Original Bid Amount: _____
 Final Construction Cost: _____
 Contract Period: _____
 Actual Contract Period: _____
 Explanation: _____

5. Project Name: _____
 Project Engineer: _____
 Original Bid Amount: _____
 Final Construction Cost: _____
 Contract Period: _____
 Actual Contract Period: _____
 Explanation: _____

N. Provide a list of projects involved with litigation, arbitration and/or mediation over the past twenty (20) years:

1. Project Name: _____
 Project Owner: _____
 Project Engineer: _____
 Date: _____
 Explanation: _____

2. Project Name: _____
 Project Owner: _____
 Project Engineer: _____
 Date: _____
 Explanation: _____

3. Project Name: _____
Project Owner: _____
Project Engineer: _____
Date: _____
Explanation: _____

4. Project Name: _____
Project Owner: _____
Project Engineer: _____
Date: _____
Explanation: _____

5. Project Name: _____
Project Owner: _____
Project Engineer: _____
Date: _____
Explanation: _____

O. Attach a rate schedule associated with equipment that includes labor, overhead and profit.

P. Additional information if Necessary.

1. _____

1.04 I HEREBY CERTIFY that as a duly authorized representative of _____
_____(bidder), the information
provided is to the best of my knowledge accurate and that failure to provide accurate
information will result in disqualification of my bid.

Signature

Name (Please Print)

Title

Date

Notary Public for South Carolina
My Commission Expires: _____

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 00 51 02

NOTICE OF AWARD

Project: Roadway, Water, and Wastewater Improvements at the Clarendon County Industrial Park		Owner: Clarendon County	Dated Owner's Contract No.:
Contract: Roadway, Water, and Wastewater Improvements at the Clarendon County Industrial Park		Engineer's Project No.: 22201-0014	
Bidder:			
Bidder's Address: (send Certified Mail, Return Receipt Requested):			

You are notified that your Bid dated _____ for the above Contract has been considered. You are the Successful Bidder and are awarded a Contract for Roadway, Water, and Wastewater Improvements at the Clarendon County Industrial Park in unincorporated Clarendon County, South Carolina.

The Contract Price of your Contract is _____ (\$ _____).

___ copies of each of the proposed Contract Documents (except Drawings) accompany this Notice of Award.
___ sets of the Drawings will be delivered separately or otherwise made available to you immediately.

You must comply with the following conditions precedent within seven (7) days of the date you receive this Notice of Award.

1. Deliver to the Owner five (5) fully executed counterparts of the Contract Documents.
2. Deliver with the executed Contract Documents the Contract security [Bonds] as specified in the Instructions to Bidders (Article 20), [and] General Conditions (Paragraph 5.01).
3. Other conditions precedent:
None

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

Within seven (7) days after you comply with the above conditions, Owner will return to you one (1) fully executed counterpart of the Contract Documents.

Clarendon County
Owner

By: _____
Authorized Signature

Tripp Duke, PMP, Procurement Director
Title

Acceptance of Notice

Receipt of the above Notice of Award is hereby acknowledged by _____
This the _____ day of _____, 2023.

Contractor

By: _____
Authorized Signature

Title

Copy to Engineer

SECTION 00 52 00

CONTRACT

THIS AGREEMENT is by and between Clarendon County

(hereinafter called "Owner") and _____

doing business as an **individual/a partnership/a corporation/a joint venture** (strike out inapplicable terms), with its primary office in the City of _____, County of _____, State of _____.

Owner and Contractor, in consideration of the mutual covenants set forth herein, agree as follows:

ARTICLE 1 - WORK

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

Roadway, Water, and Wastewater Improvements at the Clarendon County Industrial Park

ARTICLE 2 - THE PROJECT

2.01 The Project for which the Work under the Contract Documents may be the whole or only a part is generally described as follows:

Roadway, Water, and Wastewater Improvements at the Clarendon County Industrial Park

ARTICLE 3 - ENGINEER

3.01 The Project has been designed by: Alliance Consulting Engineers, Inc., who is to act as Owner's representative, assume all duties and responsibilities, and have the rights and authority assigned to Engineer in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.

ARTICLE 4 - CONTRACT TIMES

4.01 Time of the Essence

A. All time limits for Milestones for final payment as stated in the Contract Documents are of the essence of the Contract.

4.02 Dates for Substantial Completion and Final Payment

Contractor agrees that the work: Roadway, Water, and Wastewater Improvements at the Clarendon County Industrial Park in Clarendon County, South Carolina is to be completed within one hundred eighty (180) calendar days for the scope of work after the Notice to Proceed has been issued.

4.03 Liquidated Damages

- A. Contractor and Owner recognize that time is of the essence of this Agreement and that Owner will suffer financial loss if the Work is not completed within the times specified in Paragraph 4.02 above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. The parties also recognize the delays, expense, and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty), Contractor shall pay Owner \$1,500 for each day that expires after the time specified in Paragraph 4.02 for completion and readiness for final payment until the Work is completed and ready for final payment.

ARTICLE 5 - CONTRACT PRICE

5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents an amount in current funds equal to the sum of the amounts determined pursuant to Paragraphs 5.01.A below:

- A. For all Unit Price Work, an amount equal to the sum of the established unit price for each separately identified item of Unit Price Work times the estimated quantity of that item as indicated in the Bid Form attached hereto as part of these Contract Documents.

ARTICLE 6 - PAYMENT PROCEDURES

6.01 Submittal and Processing of Payments

- A. Contractor shall submit Applications for Payment in accordance with Article 14 of the General Conditions. Applications for Payment will be processed by Engineer as provided in the General Conditions.

6.02 Progress Payments; Retainage

- A. Owner shall make progress payments on account of the Contract Price on the basis of Contractor's Applications for Payment on or about the 30th day of each month during performance of the Work as provided in Paragraphs 6.02.A.1 and 6.02.A.2 below. All such payments will be measured by the schedule of values established as provided in Paragraph 2.07.A of the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no schedule of values, as provided in the General Requirements:
 - 1. Invoicing will be allowed on a monthly basis. Application for Payment shall reflect services completed through the last day of the month. Payment of invoices shall be due within thirty (30) days after receipt of an accurate, undisputed and properly submitted invoice to the County after acceptance of completed order/project.
 - 2. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Engineer may determine or Owner may withhold, including but not limited to liquidated damages, in accordance with Paragraph 14.02 of the General Conditions:
 - a. **90%** of Work completed (with the balance being Retainage).

- b. **90%** of cost of materials and equipment not incorporated in the Work (with the balance being Retainage).
2. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to **90%** of the Work completed, less such amounts as Engineer shall determine in accordance with Paragraph 14.02.B.5 of the General Conditions and less **10%** of Engineer's estimate of the value of Work to be completed or corrected as shown on the tentative list of items to be completed or corrected attached to the certificate of Substantial Completion.

6.03 Final Payment

- A. Upon final completion and acceptance of the Work in accordance with Paragraph 14.07 of the General Conditions, Owner shall pay the remainder of the Contract Price as recommended by Engineer as provided in said Paragraph 14.07.

ARTICLE 7 – CONTRACTOR'S REPRESENTATIONS

7.01 In order to induce Owner to enter into this Agreement Contractor makes the following representations:

- A. Contractor has examined and carefully studied the Contract Documents and the other related data identified in the Bidding Documents.
- B. Contractor has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
- C. Contractor is familiar with and is satisfied as to all federal, state, and local Laws and Regulations that may affect cost, progress, and performance of the Work.
- D. Contractor has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) which have been identified in Paragraph 4.02 of the General Conditions and (2) reports and drawings of a Hazardous Environmental Condition, if any, at the Site which has been identified in Paragraph 4.06 of the General Conditions.
- E. Contractor has obtained and carefully studied (or assumes responsibility for doing so) all examinations, investigations, explorations, tests, studies, and data concerning conditions (surface, subsurface, and Underground Facilities) at or contiguous to the Site which may affect cost, progress, or performance of the Work or which relate to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, including any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents, and safety precautions and programs incident thereto.
- F. Contractor does not consider that any further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract Documents.
- G. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.
- H. Contractor has correlated the information known to Contractor, information and observations obtained from visits to the Site, reports and drawings identified in the Contract Documents,

and all additional examinations, investigations, explorations, tests, studies, and data with the Contract Documents.

- I. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
- J. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

ARTICLE 8 - CONTRACT DOCUMENTS

8.01 Contents

- A. The Contract Documents consist of the following:
 - 1. This Agreement (Section 00 52 00).
 - 2. Performance Bond (Section 00 61 13.13).
 - 3. Payment Bond (Section 00 61 13.16).
 - 4. General Conditions (Section 00 70 00).
 - 5. Contractor/Subcontract Qualifications (Section 00 45 13)
 - 6. Drawings Index (Section 00 01 15)
 - 7. Exhibits to this Agreement (enumerated as follows):
 - a. Contractor's Bid (Section 00 41 00)
 - 8. The following which may be delivered or issued on or after the Effective Date of the Agreement and are not attached hereto:
 - a. Notice to Proceed (Section 00 55 00).
 - b. Work Change Directives as issued.
 - c. Change Order(s) as issued.
- B. The documents listed in Paragraph 9.01.A are attached to this Agreement (except as expressly noted otherwise above).
- C. There are no Contract Documents other than those listed above in this Article 9.
- D. The Contract Documents may only be amended, modified, or supplemented as provided in Paragraph 3.04 of the General Conditions.

ARTICLE 9 - MISCELLANEOUS

9.01 Terms

- A. Terms used in this Agreement will have the meanings stated in the General Conditions.

9.02 Assignment of Contract

- A. No assignment by a party hereto of any rights under or interests in the Contract will be binding on another party hereto without the written consent of the party sought to be bound; and, specifically but without limitation, moneys that may become due and moneys that are due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

9.03 Successors and Assigns

- A. Owner and Contractor each binds itself, its partners, successors, assigns, and legal representatives to the other party hereto, its partners, successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

9.04 Severability

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

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement. One counterpart each has been delivered to Owner, Contractor, Engineer and provided to the Contractor for their Bonding Agency. All portions of the Contract Documents have been signed or identified by Owner and Contractor or on their behalf.

This Agreement will be effective on this _____ day of _____, 2023 (which is the Effective Date of the Agreement).

OWNER:

CONTRACTOR:

Clarendon County

By: _____

Title: **Tripp Duke, PMP**
Procurement Director

[CORPORATE SEAL]

Attest: _____

Title: _____

Address for giving notices:

Clarendon County

411 Sunset Drive

Manning, South Carolina, 29102

By: _____

Title: _____

[CORPORATE SEAL]

Attest: _____

Title: _____

Address for giving notices:

License No.: _____
(Where applicable)

Agent for service or
process: _____

SECTION 00 55 00

NOTICE TO PROCEED

Dated:

Project: Roadway, Water, and Wastewater Improvements at the Clarendon County Industrial Park	Owner: Clarendon County	Owner's Contract No.:
Contract: Roadway, Water, and Wastewater Improvements at the Clarendon County Industrial Park	Engineer's Project No.: 22201-0014	

Contractor:

Contractor's Address: [send Certified Mail, Return Receipt Requested]

You are notified that the Contract Times under the above contract will commence to run on _____. On or before that date, you are to start performing your obligations under the Contract Documents. In accordance with Article 4 of the Agreement, the date of Substantial Completion is _____, and the date of readiness for final payment is _____.

Before you may start any Work at the Site, Paragraph 2.01.B of the General Conditions provides that you and Owner must each deliver to the other (with copies to Engineer and other identified additional insureds) certificates of insurance which each is required to purchase and maintain in accordance with the Contract Documents.

Contractor by:	<u>Clarendon County</u>
Title	Owner
Date	Given by:
	Tripp Duke, PMP
	Procurement Director
	Title
	Date

Copy to Engineer

SECTION 00 61 13.13

PERFORMANCE BOND

Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

CONTRACTOR (Name and Address):

SURETY (Name and Address of Principal Place of Business):

OWNER (Name and Address): **Clarendon County
411 Sunset Drive
Manning, South Carolina, 29102**

CONTRACT

Date:
Amount:

Description (Name and Location): **Roadway, Water, and Wastewater Improvements at the Clarendon County Industrial Park**

BOND

Bond Number:
Date (Not earlier than Contract Date):
Amount:
Modifications to this Bond Form:

Surety and Contractor, intending to be legally bound hereby, subject to the terms printed on the reverse side hereof, do each cause this Performance Bond to be duly executed on its behalf by its authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL
Company:

SURETY

Signature: _____ (Seal)
Name and Title:

Surety's Name and Corporate Seal (Seal)

By: _____
Signature and Title
(Attach Power of Attorney)

(Space is provided below for signatures of additional parties, if required.)

Attest: _____
Signature and Title

CONTRACTOR AS PRINCIPAL
Company:

SURETY

Signature: _____ (Seal)
Name and Title:

Surety's Name and Corporate Seal (Seal)

By: _____
Signature and Title
(Attach Power of Attorney)

Attest: _____
Signature and Title:

1. Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to Owner for the performance of the Contract, which is incorporated herein by reference.
2. If Contractor performs the Contract, Surety and Contractor have no obligation under this Bond, except to participate in conferences as provided in Paragraph 3.1.
3. If there is no Owner Default, Surety's obligation under this Bond shall arise after:
 - 3.1. Owner has notified Contractor and Surety, at the addresses described in Paragraph 10 below, that Owner is considering declaring a Contractor Default and has requested and attempted to arrange a conference with Contractor and Surety to be held not later than 15 days after receipt of such notice to discuss methods of performing the Contract. If Owner, Contractor and Surety agree, Contractor shall be allowed a reasonable time to perform the Contract, but such an agreement shall not waive Owner's right, if any, subsequently to declare a Contractor Default; and
 - 3.2. Owner has declared a Contractor Default and formally terminated Contractor's right to complete the Contract. Such Contractor Default shall not be declared earlier than 20 days after Contractor and Surety have received notice as provided in Paragraph 3.1; and
 - 3.3. Owner has agreed to pay the Balance of the Contract Price to:
 1. Surety in accordance with the terms of the Contract;
 2. Another contractor selected pursuant to Paragraph 4.3 to perform the Contract.
4. When Owner has satisfied the conditions of Paragraph 3, Surety shall promptly and at Surety's expense take one of the following actions:
 - 4.1. Arrange for Contractor, with consent of Owner, to perform and complete the Contract; or
 - 4.2. Undertake to perform and complete the Contract itself, through its agents or through independent contractors; or
 - 4.3. Obtain bids or negotiated proposals from qualified contractors acceptable to Owner for a contract for performance and completion of the Contract, arrange for a contract to be prepared for execution by Owner and Contractor selected with Owner's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Contract, and pay to Owner the amount of damages as described in Paragraph 6 in excess of the Balance of the Contract Price incurred by Owner resulting from Contractor Default; or
 - 4.4. Waive its right to perform and complete, arrange for completion, or obtain a new contractor and with reasonable promptness under the circumstances:
 1. After investigation, determine the amount for which it may be liable to Owner and, as soon as practicable after the amount is determined, tender payment therefor to Owner; or
 2. Deny liability in whole or in part and notify Owner citing reasons therefor.
5. If Surety does not proceed as provided in Paragraph 4 with reasonable promptness, Surety shall be deemed to be in default on this Bond 15 days after receipt of an additional written notice from Owner to Surety demanding that Surety perform its obligations under this Bond, and Owner shall be entitled to enforce any remedy available to Owner. If Surety proceeds as provided in Paragraph 4.4, and Owner refuses the payment tendered or Surety has denied liability, in whole or in part, without further notice Owner shall be entitled to enforce any remedy available to Owner.
6. After Owner has terminated Contractor's right to complete the Contract, and if Surety elects to act under Paragraph 4.1, 4.2, or 4.3 above, then the responsibilities of Surety to Owner shall not be greater than those of Contractor under the Contract, and the responsibilities of Owner to Surety shall not be greater than those of Owner under the Contract. To a limit of the amount of this Bond, but subject to commitment by Owner of the Balance of the Contract Price to mitigation of costs and damages on the Contract, Surety is obligated without duplication for:
 - 6.1. The responsibilities of Contractor for correction of defective Work and completion of the Contract;
 - 6.2. Additional legal, design professional, and delay costs resulting from Contractor's Default, and resulting from the actions or failure to act of Surety under Paragraph 4; and
 - 6.3. Liquidated damages, or if no liquidated damages are specified in the Contract, actual damages caused by delayed performance or non-performance of Contractor.
7. Surety shall not be liable to Owner or others for obligations of Contractor that are unrelated to the Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than Owner or its heirs, executors, administrators, or successors.
8. Surety hereby waives notice of any change, including changes of time, to Contract or to related subcontracts, purchase orders, and other obligations.
9. Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the Work or part of the Work is located and shall be instituted within two years after Contractor Default or within two years after Contractor ceased working or within two years after Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.
10. Notice to Surety, Owner, or Contractor shall be mailed or delivered to the address shown on the signature page.
11. When this Bond has been furnished to comply with a statutory requirement in the location where the Contract was to be performed, any provision in this Bond conflicting with said statutory requirement shall be deemed deleted herefrom and provisions conforming to such statutory requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory bond and not as a common law bond.
12. Definitions.
 - 12.1 Balance of the Contract Price: The total amount payable by Owner to Contractor under the Contract after all proper adjustments have been made, including allowance to Contractor of any amounts received or to be received by Owner in settlement of insurance or other Claims for damages to which Contractor is entitled, reduced by all valid and proper payments made to or on behalf of Contractor under the Contract.
 - 12.2. Contract: The agreement between Owner and Contractor identified on the signature page, including all Contract Documents and changes thereto.
 - 12.3. Contractor Default: Failure of Contractor, which has neither been remedied nor waived, to perform or otherwise to comply with the terms of the Contract.
 - 12.4. Owner Default: Failure of Owner, which has neither been remedied nor waived, to pay Contractor as required by the Contract or to perform and complete or comply with the other terms thereof.

FOR INFORMATION ONLY – Name, Address and Telephone

Surety Agency or Broker:

Owner's Representative (engineer or other party):

Alliance Consulting Engineers, Inc.
P.O. Box 8147
Columbia, SC 29202-8147
(803) 779-2078

SECTION 00 61 13.16

PAYMENT BOND

Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

CONTRACTOR (Name and Address):

SURETY (Name and Address of Principal Place of Business):

OWNER: **Clarendon County
411 Sunset Drive
Manning, South Carolina, 29102**

CONTRACT

Date:

Amount:

Description (Name and Location): **Roadway, Water, and Wastewater Improvements at the Clarendon County Industrial Park**

BOND

Bond Number:

Date (Not earlier than Contract Date):

Amount:

Modifications to this Bond Form:

Surety and Contractor, intending to be legally bound hereby, subject to the terms printed on the reverse side hereof, do each cause this Payment Bond to be duly executed on its behalf by its authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

SURETY

Company:

Signature: _____ (Seal)

Name and Title:

Surety's Name and Corporate Seal (Seal)

By:

Signature and Title
(Attach Power of Attorney)

(Space is provided below for signatures of additional parties, if required.)

Attest:

Signature and Title

CONTRACTOR AS PRINCIPAL

SURETY

Company:

Signature: _____ (Seal)

Name and Title:

Surety's Name and Corporate Seal (Seal)

By:

Signature and Title
(Attach Power of Attorney)

Attest:

Signature and Title:

1. Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to Owner to pay for labor, materials, and equipment furnished by Claimants for use in the performance of the Contract, which is incorporated herein by reference.
2. With respect to Owner, this obligation shall be null and void if Contractor:
 - 2.1. Promptly makes payment, directly or indirectly, for all sums due Claimants, and
 - 2.2. Defends, indemnifies, and holds harmless Owner from all claims, demands, liens, or suits alleging non-payment by Contractor by any person or entity who furnished labor, materials, or equipment for use in the performance of the Contract, provided Owner has promptly notified Contractor and Surety (at the addresses described in Paragraph 12) of any claims, demands, liens, or suits and tendered defense of such claims, demands, liens, or suits to Contractor and Surety, and provided there is no Owner Default.
3. With respect to Claimants, this obligation shall be null and void if Contractor promptly makes payment, directly or indirectly, for all sums due.
4. Surety shall have no obligation to Claimants under this Bond until:
 - 4.1. Claimants who are employed by or have a direct contract with Contractor have given notice to Surety (at the addresses described in Paragraph 12) and sent a copy, or notice thereof, to Owner, stating that a claim is being made under this Bond and, with substantial accuracy, the amount of the claim.
 - 4.2. Claimants who do not have a direct contract with Contractor:
 1. Have furnished written notice to Contractor and sent a copy, or notice thereof, to Owner, within 90 days after having last performed labor or last furnished materials or equipment included in the claim stating, with substantial accuracy, the amount of the claim and the name of the party to whom the materials or equipment were furnished or supplied, or for whom the labor was done or performed; and
 2. Have either received a rejection in whole or in part from Contractor, or not received within 30 days of furnishing the above notice any communication from Contractor by which Contractor had indicated the claim will be paid directly or indirectly; and
 3. Not having been paid within the above 30 days, have sent a written notice to Surety and sent a copy, or notice thereof, to Owner, stating that a claim is being made under this Bond and enclosing a copy of the previous written notice furnished to Contractor.
5. If a notice by a Claimant required by Paragraph 4 is provided by Owner to Contractor or to Surety, that is sufficient compliance.
6. When a Claimant has satisfied the conditions of Paragraph 4, the Surety shall promptly and at Surety's expense take the following actions:
 - 6.1. Send an answer to that Claimant, with a copy to Owner, within 45 days after receipt of the claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed.
 - 6.2. Pay or arrange for payment of any undisputed amounts.
7. Surety's total obligation shall not exceed the amount of this Bond, and the amount of this Bond shall be credited for any payments made in good faith by Surety.
8. Amounts owed by Owner to Contractor under the Contract shall be used for the performance of the Contract and to satisfy claims, if any, under any performance bond. By Contractor furnishing and Owner accepting this Bond, they agree that all funds earned by Contractor in the performance of the Contract are dedicated to satisfy obligations of Contractor and Surety under this Bond, subject to Owner's priority to use the funds for the completion of the Work.
9. Surety shall not be liable to Owner, Claimants, or others for obligations of Contractor that are unrelated to the Contract. Owner shall not be liable for payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligations to make payments to, give notices on behalf of, or otherwise have obligations to Claimants under this Bond.
10. Surety hereby waives notice of any change, including changes of time, to the Contract or to related Subcontracts, purchase orders and other obligations.
11. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the location in which the Work or part of the Work is located or after the expiration of one year from the date (1) on which the Claimant gave the notice required by Paragraph 4.1 or Paragraph 4.2.3, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.
12. Notice to Surety, Owner, or Contractor shall be mailed or delivered to the addresses shown on the signature page. Actual receipt of notice by Surety, Owner, or Contractor, however accomplished, shall be sufficient compliance as of the date received at the address shown on the signature page.
13. When this Bond has been furnished to comply with a statutory requirement in the location where the Contract was to be performed, any provision in this Bond conflicting with said statutory requirement shall be deemed deleted herefrom and provisions conforming to such statutory requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory Bond and not as a common law bond.
14. Upon request of any person or entity appearing to be a potential beneficiary of this Bond, Contractor shall promptly furnish a copy of this Bond or shall permit a copy to be made.

15. DEFINITIONS

- 15.1. Claimant: An individual or entity having a direct contract with Contractor, or with a first-tier subcontractor of Contractor, to furnish labor, materials, or equipment for use in the performance of the Contract. The intent of this Bond shall be to include without limitation in the terms "labor, materials or equipment" that part of water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Contract, architectural and engineering services required for performance of the Work of Contractor and Contractor's Subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.
- 15.2. Contract: The agreement between Owner and Contractor identified on the signature page, including all Contract Documents and changes thereto.
- 15.3. Owner Default: Failure of Owner, which has neither been remedied nor waived, to pay Contractor as required by the Contract or to perform and complete or comply with the other terms thereof.

FOR INFORMATION ONLY – Name, Address and Telephone

Surety Agency or Broker:

**Owner's Representative: Alliance Consulting Engineers, Inc.
P.O. Box 8147
Columbia, SC 29202-8147
(803) 779-2078**

SECTION 00 62 76

APPLICATION FOR PAYMENT

Contractor's Application For Payment No. _____

Application Period:	Application Date:
To (Owner): Clarendon County	From (Contractor):
Project: Roadway, Water, and Wastewater Improvements at the Clarendon County Industrial Park	Via (Engineer): Alliance Consulting Engineers, Inc.
Contract:	
Owner's Contract No.:	Contractor's Project No.:
	Engineer's Project No.: 22201-0014

APPLICATION FOR PAYMENT

Change Order Summary

Approved Change Orders		
Number	Additions	Deductions
TOTALS		
NET CHANGE BY CHANGE ORDERS		

1. ORIGINAL CONTRACT PRICE	\$	_____
2. Net change by Change Orders.....	\$	_____
3. CURRENT CONTRACT PRICE (Line 1 ± 2)	\$	_____
4. TOTAL COMPLETED AND STORED TO DATE (Column F on Progress Estimate)	\$	_____
5. RETAINAGE:		
a. ____ % x \$ _____ Work Completed	\$	_____
b. ____ % x \$ _____ Stored Material.....	\$	_____
c. Total Retainage (Line 5a + Line 5b)	\$	_____
6. AMOUNT ELIGIBLE TO DATE (Line 4 - Line 5c)	\$	_____
7. LESS PREVIOUS PAYMENTS (Line 6 from prior Application)	\$	_____
8. AMOUNT DUE THIS APPLICATION	\$	_____
9. BALANCE TO FINISH, PLUS RETAINAGE (Column G on Progress Estimate + Line 5 above).....	\$	_____

CONTRACTOR'S CERTIFICATION

The undersigned Contractor certifies that: (1) all previous progress payments received from Owner on account of Work done under the Contract have been applied on account to discharge Contractor's legitimate obligations incurred in connection with Work covered by prior Applications for Payment; (2) title of all Work, materials and equipment incorporated in said Work or otherwise listed in or covered by this Application for Payment will pass to Owner at time of payment free and clear of all Liens, security interests and encumbrances (except such as are covered by a Bond acceptable to Owner indemnifying Owner against any such Liens, security interest or encumbrances); and (3) all Work covered by this Application for Payment is in accordance with the Contract Documents and is not defective.

Payment of: \$ _____
(Line 8 or other - attach explanation of other amount)

is recommended by: _____
John V. Burbage, P.E. (Date)

Payment of: \$ _____
(Line 8 or other - attach explanation of other amount)

is approved by: _____
Tripp Duke, PMP, Procurement Director (Date)

By: _____ Date: _____

Progress Estimate

Contractor's Application

For (contract): Roadway, Water, and Wastewater Improvements at the Clarendon County Industrial Park						Application Number:		
Application Period:						Application Date:		
A		B	Work Completed		E	F		G
Item		Scheduled Value	C	D	Materials Presently Stored (not in C or D)	Total Completed and Stored to Date (C + D + E)	% (E) B	Balance to Finish (B - F)
Specification Section No.	Description		From Previous Application (C + D)	This Period				
Totals								

Stored Material Summary

Contractor's Application

For (contract): Roadway, Water, and Wastewater Improvements at the Clarendon County Industrial Park						Application Number:			
Application Period:						Application Date:			
A	B	C	D		E		F		G
Invoice No.	Shop Drawing Transmittal No.	Materials Description	Stored Previously		Stored this Month		Incorporated in Work		Materials Remaining in Storage (\$) (D + E - F)
			Date (Month/Year)	Amount (\$)	Amount (\$)	Subtotal	Date (Month/Year)	Amount (\$)	
		Totals							

SECTION 00 63 49
WORK CHANGE DIRECTIVE

No. _____

Date of Issuance: _____ Effective Date: _____

Project: Roadway, Water, and Wastewater Improvements at the Clarendon County Industrial Park	Owner: Clarendon County	Owner's Contract No.:
Contract: Roadway, Water, and Wastewater Improvements at the Clarendon County Industrial Park	Date of Contract:	
Contractor:		Engineer's Project No.: 22201-0014

You are directed to proceed promptly with the following change(s):

Item No.	Description

Attachments (list documents supporting change):

Purpose for Work Change Directive:

- Authorization for Work described herein to proceed on the basis of Cost of the Work due to:
- Nonagreement on pricing of proposed change.
- Necessity to expedite Work described herein prior to agreeing to changes on Contract Price and Contract Time.

Estimated change in Contract Price and Contract Times:

Contract Price \$ _____ (increase/decrease) Contract Time _____ (increase/decrease)
days

If the change involves an increase, the estimated amounts are not to be exceeded without further authorization.

Recommended for Approval by Engineer: John V. Burbage, P.E.	Date
Authorized for Owner by: Tripp Duke, PMP, Procurement Director	Date
Accepted for Contractor by:	Date
Approved by Funding Agency (if applicable):	Date:

SECTION 00 63 63

CHANGE ORDER

No. _____

Date of Issuance: _____

Effective Date: _____

Project: Roadway, Water, and Wastewater Improvements at the Clarendon County Industrial Park	Owner: Clarendon County	Owner's Contract No.:
Contract: Roadway, Water, and Wastewater Improvements at the Clarendon County Industrial Park	Date of Contract:	
Contractor:	Engineer's Project No.: 22201-0014	

The Contract Documents are modified as follows upon execution of this Change Order:

Description:

Attachments: (List documents supporting change):

CHANGE IN CONTRACT PRICE:

CHANGE IN CONTRACT TIMES:

Original Contract Price:

\$ _____

Original Contract Times: Working days Calendar days
Substantial completion (days or date): _____
Ready for final payment (days or date): _____

[Increase] [Decrease] from previously approved Change Orders No. _____ to No. _____:

\$ _____

[Increase] [Decrease] from previously approved Change Orders No. _____ to No. _____:
Substantial completion (days): _____
Ready for final payment (days): _____

Contract Price prior to this Change Order:

\$ _____

Contract Times prior to this Change Order:
Substantial completion (days or date): _____
Ready for final payment (days or date): _____

[Increase] [Decrease] of this Change Order:

\$ _____

[Increase] [Decrease] of this Change Order:
Substantial completion (days or date): _____
Ready for final payment (days or date): _____

Contract Price incorporating this Change Order:

\$ _____

Contract Times with all approved Change Orders:
Substantial completion (days or date): _____
Ready for final payment (days or date): _____

RECOMMENDED:

APPROVED:

APPROVED:

By: _____
Contractor:

By: _____
Owner: Tripp Duke, PMP, Procurement Director

By: _____
Engineer: John V. Burbage, P.E.

Date: _____

Date: _____

Date: _____

Approved by Funding Agency (if applicable): _____

Date: _____

SECTION 00 65 16

CERTIFICATE OF SUBSTANTIAL COMPLETION

Project: Roadway, Water, and Wastewater Improvements at the Clarendon County Industrial Park	Owner: Clarendon County	Owner's Contract No.:
Contract: Roadway, Water, and Wastewater Improvements at the Clarendon County Industrial Park	Date of Contract:	
Contractor:	Engineer's Project No.: 22201-0014	

This [tentative] [definitive] Certificate of Substantial Completion applies to:

- All Work under the Contract Documents: The following specified portions:

Date of Substantial Completion

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor and Engineer, and found to be substantially complete. The Date of Substantial Completion of the Project or portion thereof designated above is hereby declared and is also the date of commencement of applicable warranties required by the Contract Documents, except as stated below.

A [tentative] [revised tentative] [definitive] list of items to be completed or corrected, is attached hereto. This list may not be all-inclusive, and the failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

The responsibilities between OWNER and CONTRACTOR for security, operation, safety, maintenance, heat, utilities, insurance and warranties shall be as provided in the Contract Documents except as amended as follows:

- Amended Responsibilities Not Amended

Owner's Amended Responsibilities:

Contractor's Amended Responsibilities:

The following documents are attached to and made part of this Certificate:

This Certificate does not constitute an acceptance of Work not in accordance with the Contract Documents nor is it a release of Contractor's obligation to complete the Work in accordance with the Contract Documents.

Executed by Engineer: John V. Burbage, P.E., Alliance Consulting Engineers, Inc.	Date
Accepted by Contractor:	Date
Accepted by Owner: Tripp Duke, PMP, Procurement Director	Date

SECTION 00 65 19.13

CONTRACTOR'S AFFIDAVIT

The State of _____ Date: _____

The County of _____

The City/Town of _____

_____ of _____
(Officer's Name) (Officer's Title) (Contractor's Name)

being duly sworn, deposes and says that _____
(Contractor's Name)

has furnished all labor and material entering into the **Roadway, Water, and Wastewater Improvements at the Clarendon County Industrial Park**

called for in the Contract Documents dated _____ with _____

Clarendon County states further that this officer has full knowledge of all obligations for such labor and materials, which have entered into and become part of that certain project known and designated above, and that this officer further deposes and says that all debts and other obligations for such labor and materials have been fully and completely paid for in good and lawful money of the United States of America and that there are no suits for damages against them proceeding, prospective and/or that there are no suits for damages against them proceeding, prospective, or otherwise, in consequence of their operations on the above said project.

The said _____ will hold the Owners,
(Contractor's Name)

Clarendon County, blameless of any and all mechanic's liens that may be hereafter entered or filed for record, so as to constitute charge against said premises for work or labor done or materials furnished by them.

IN WITNESS HEREOF, this officer has heretofore put their hand and seal:

(Seal)
(Officer's Name)

I, _____, Notary Public in and for the above named County and State do

hereby certify that _____ personally known to me to be the affiant in the
(Officer's Name)

foregoing Affidavit, personally appeared before me this day and, having been duly sworn, deposes and says that the facts set forth in the above Affidavit are true and correct.

WITNESS my hand and seal this ____ day of _____, 2020

(Seal)

Notary Public for the State of _____ My Commission Expires: _____

SECTION 00 70 00

GENERAL CONDITIONS

PART 1 - DEFINITIONS AND TERMINOLOGY

1.01 Defined Terms

- A. Wherever used in the Bidding Requirements or Contract Documents and printed with initial capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified Parts and paragraphs, and the titles of other documents or forms.
1. Addenda – Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.
 2. Agreement – The written instrument which is evidence of the agreement between Owner and Contractor covering the Work.
 3. Application for Payment – The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.
 4. Asbestos – Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.
 5. Bid – The offer or proposal of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.
 6. Bidder – The individual or entity who submits a Bid directly to Owner.
 7. Bidding Documents – The Bidding Requirements and the proposed Contract Documents (including all Addenda).
 8. Bidding Requirements – The Advertisement or Invitation to Bid, Instructions to Bidders, bid security of acceptable form, if any, and the Bid Form with any supplements.
 9. Change Order – A document recommended by Engineer which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement.
 10. Claim – A demand or assertion by Owner or Contractor seeking an adjustment of Contract Price or Contract Times, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a Claim.
 11. Contract – The entire and integrated written agreement between the Owner and Contractor concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.

12. Contract Documents – Those items so designated in the Agreement. Only printed or hard copies of the items listed in the Agreement are Contract Documents. Approved Shop Drawings, other Contractor's submittals, and the reports and drawings of subsurface and physical conditions are not Contract Documents.
13. Contract Price – The moneys payable by Owner to Contractor for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of Paragraph 11.03 in the case of Unit Price Work).
14. Contract Times – The number of days or the dates stated in the Agreement to: (i) achieve Milestones, if any, (ii) achieve Substantial Completion; and (iii) complete the Work so that it is ready for final payment as evidenced by Engineer's written recommendation of final payment.
15. Contractor – The individual or entity with whom Owner has entered into the Agreement.
16. Cost of the Work – See Paragraph 11.01.A for definition.
17. Drawings – That part of the Contract Documents prepared or approved by Engineer which graphically shows the scope, extent, and character of the Work to be performed by Contractor. Shop Drawings and other Contractor submittals are not Drawings as so defined.
18. Effective Date of the Agreement – The date indicated in the Agreement on which it becomes effective, but if no such date is indicated, it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.
19. Engineer – The individual or entity named as such in the Agreement.
20. Field Order – A written order issued by Engineer which requires minor changes in the Work but which does not involve a change in the Contract Price or the Contract Times.
21. General Requirements – Sections of Division 1 of the Specifications. The General Requirements pertain to all sections of the Specifications.
22. Hazardous Environmental Condition – The presence at the Site of Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material in such quantities or circumstances that may present a substantial danger to persons or property exposed thereto in connection with the Work.
23. Hazardous Waste – The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.
24. Laws and Regulations; Laws or Regulations – Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.
25. Liens – Charges, security interests, or encumbrances upon Project funds, real property, or personal property.
26. Milestone – A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.

27. Notice of Award – The written notice by Owner to the Successful Bidder stating that upon timely compliance by the Successful Bidder with the conditions precedent listed therein, Owner will sign and deliver the Agreement.
28. Notice to Proceed – A written notice given by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work under the Contract Documents.
29. Owner – The individual or entity with whom Contractor has entered into the Agreement and for whom the Work is to be performed.
30. PCBs – Polychlorinated biphenyls.
31. Petroleum – Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Waste and crude oils.
32. Progress Schedule – A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times.
33. Project – The total construction of which the Work to be performed under the Contract Documents may be the whole, or a part.
34. Project Manual – The bound documentary information prepared for bidding and constructing the Work. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.
35. Radioactive Material – Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.
36. Related Entity – An officer, director, partner, employee, agent, consultant, or subcontractor.
37. Resident Project Representative – The authorized representative of Engineer who may be assigned to the Site or any part thereof.
38. Samples – Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.
39. Schedule of Submittals – A schedule, prepared and maintained by Contractor, of required submittals and the time requirements to support scheduled performance of related construction activities.
40. Schedule of Values – A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.
41. Shop Drawings – All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.

42. Site – Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements for access thereto, and such other lands furnished by Owner which are designated for the use of Contractor.
43. Specifications – That part of the Contract Documents consisting of written requirements for materials, equipment, systems, standards and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable thereto.
44. Subcontractor – An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the Site.
45. Substantial Completion – The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms “substantially complete” and “substantially completed” as applied to all or part of the Work refer to Substantial Completion thereof.
46. Successful Bidder – The Bidder submitting a responsive Bid to whom Owner makes an award.
47. Supplementary Conditions – That part of the Contract Documents which amends or supplements these General Conditions.
48. Supplier – A manufacturer, fabricator, supplier, distributor, material man, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or any Subcontractor.
49. Underground Facilities – All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.
50. Unit Price Work – Work to be paid for on the basis of unit prices.
51. Work – The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.
52. Work Change Directive – A written statement to Contractor issued on or after the Effective Date of the Agreement and signed by Owner and recommended by Engineer ordering an addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

1.02 Terminology

- A. The following words or terms are not defined but, when used in the Bidding Requirements or Contract Documents, have the following meaning.
- B. Intent of Certain Terms or Adjectives
1. The Contract Documents include the terms “as allowed,” “as approved,” “as ordered,” “as directed” or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives “reasonable,” “suitable,” “acceptable,” “proper,” “satisfactory,” or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action or determination will be solely to evaluate, in general, the Work for compliance with the requirements of and information in the Contract Documents and conformance with the design concept of the completed Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of Paragraph 9.09 or any other provision of the Contract Documents.
- C. Day
1. The word “day” means a calendar day of 24 hours measured from midnight to the next midnight.
- D. Defective
1. The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
 - a. does not conform to the Contract Documents, or
 - b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents, or
 - c. has been damaged prior to Engineer’s recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 14.04 or 14.05).
- E. Furnish, Install, Perform, Provide
1. The word “furnish,” when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.
 2. The word “install,” when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.
 3. The words “perform” or “provide,” when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.

4. When “furnish,” “install,” “perform,” or “provide” is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, “provide” is implied.
- F. Unless stated otherwise in the Contract Documents, words or phrases which have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

PART 2 - PRELIMINARY MATTERS

2.01 Delivery of Bonds and Evidence of Insurance

- A. When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.
- B. Evidence of Insurance: Before any Work at the Site is started, Contractor and Owner shall each deliver to the other, with copies to each additional insured identified in the General Conditions, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which Contractor and Owner respectively are required to purchase and maintain in accordance with Part 5.

2.02 Copies of Documents

- A. Owner shall furnish to Contractor up to six (6) printed or hard copies of the Drawings and Project Manual. Additional copies will be furnished upon request at the cost of reproduction.

2.03 Commencement of Contract Times; Notice to Proceed

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

2.04 Starting the Work

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

2.05 Before Starting Construction

- A. *Preliminary Schedules:* Within ten (10) days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), Contractor shall submit to Engineer for timely review:
 1. a preliminary Progress Schedule; indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract Documents;
 2. a preliminary Schedule of Submittals; and

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

2.06 Preconstruction Conference

- A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.05.A, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, and maintaining required records.

2.07 Initial Acceptance of Schedules

- A. At least ten (10) days before submission of the first Application for Payment a conference attended by Contractor, Engineer, and others as appropriate will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.05.A. Contractor shall have an additional ten (10) days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.
 1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work nor interfere with or relieve Contractor from Contractor's full responsibility therefor.
 2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.
 3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to component parts of the Work.

PART 3 – CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 Intent

- A. The Contract Documents are complementary; what is required by one is as binding as if required by all.
- B. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended result will be provided whether or not specifically called for at no additional cost to Owner.
- C. Clarifications and interpretations of the Contract Documents shall be issued by Engineer as provided in Part 9.

3.02 Reference Standards

A. Standards, Specifications, Codes, Laws, and Regulations

1. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.
2. No provision of any such standard, specification, manual or code, or any instruction of a Supplier shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees from those set forth in the Contract Documents. No such provision or instruction shall be effective to assign to Owner, or Engineer, or any of, their Related Entities, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

3.03 Reporting and Resolving Discrepancies

A. Reporting Discrepancies

1. *Contractor's Review of Contract Documents Before Starting Work:* Before undertaking each part of the Work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy which Contractor may discover and shall obtain a written interpretation or clarification from Engineer before proceeding with any Work affected thereby.
2. *Contractor's Review of Contract Documents During Performance of Work:* If, during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents or between the Contract Documents and any provision of any Law or Regulation applicable to the performance of the Work or of any standard, specification, manual or code, or of any instruction of any Supplier, Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 6.16.A) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in Paragraph 3.04.
3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor knew or reasonably should have known thereof.

B. Resolving Discrepancies

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:
 - a. the provisions of any standard, specification, manual, code, or instruction (whether or not specifically incorporated by reference in the Contract Documents); or

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

3.04 Amending and Supplementing Contract Documents

- A. The Contract Documents may be amended to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof by either a Change Order or a Work Change Directive.
- B. The requirements of the Contract Documents may be supplemented and minor variations and deviations in the Work may be authorized, by one or more of the following ways:
 - 1. A Field Order;
 - 2. Engineer's approval of a Shop Drawing or Sample; (Subject to the provisions of Paragraph 6.17.D.3); or
 - 3. Engineer's written interpretation or clarification.

3.05 Reuse of Documents

- A. Contractor and any Subcontractor or Supplier or other individual or entity performing or furnishing all of the Work under a direct or indirect contract with Contractor, shall not:
 - 1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or Engineer's consultants, including electronic media editions; or
 - 2. reuse any of such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaption by Engineer.
- B. The prohibition of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

3.06 Electronic Data

- A. Copies of data furnished by Owner or Engineer to Contractor or Contractor to Owner or Engineer that may be relied upon are limited to the printed copies (also known as hard copies). Files in electronic media format of text, data, graphics, or other types are furnished only for the convenience of the receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, the hard copies govern.
- B. Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic files agrees that it will perform acceptance tests or procedures within 60 days, after which the receiving party shall be deemed to have accepted the data thus transferred. Any errors detected within the 60-day acceptance period will be corrected by the transferring party.
- C. When transferring documents in electronic media format, the transferring party makes no representations as to long term compatibility, usability, or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the data's creator.

PART 4 - AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS; REFERENCE POINTS

4.01 Availability of Lands

- A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work. Owner will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If Contractor and Owner are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, as a result of any delay in Owner's furnishing the Site or a part thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.
- B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which the Work is to be performed and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.
- C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

4.02 Subsurface and Physical Conditions

- A. Reports and Drawings: Reports of explorations and tests of subsurface conditions at or contiguous to the Site that Engineer has used in preparing the Bidding Documents including the Soil Borings have been completed for the project by S&ME, Inc. dated February 1, 2023.

4.03 Differing Subsurface or Physical Conditions

- A. Notice: If Contractor believes that any subsurface or physical condition at or contiguous to the Site that is uncovered or revealed either:
 - 1. is of such a nature as to establish that any "technical data" on which Contractor is entitled to rely as provided in Paragraph 4.02 is materially inaccurate; or
 - 2. is of such a nature as to require a change in the Contract Documents; or
 - 3. differs materially from that shown or indicated in the Contract Documents; or
 - 4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except as aforesaid) until receipt of written order to do so.

- B. Engineer's Review: After receipt of written notice as required by Paragraph 4.03.A, Engineer will promptly review the pertinent condition, determine the necessity of Owner's obtaining additional exploration or tests with respect thereto, and advise Owner in writing (with a copy to Contractor) of Engineer's findings and conclusions.

C. Possible Price and Times Adjustments

1. The Contract Price or the Contract Times, or both, will be equitably adjusted to the extent that the existence of such differing subsurface or physical condition causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. such condition must meet any one or more of the categories described in Paragraph 4.03.A; and
 - b. with respect to Work that is paid for on a Unit Price Basis, any adjustment in Contract Price will be subject to the provisions of Paragraphs 9.07 and 11.03.
2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times if:
 - a. Contractor knew of the existence of such conditions at the time Contractor made a final commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract; or
 - b. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such final commitment; or
 - c. Contractor failed to give the written notice as required by Paragraph 4.03.A.
3. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, a Claim may be made therefor as provided in Paragraph 10.05. However, Owner and Engineer, and any of their Related Entities shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

4.04 Underground Facilities

- A. Shown or Indicated: The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others:
 1. Owner and Engineer shall not be responsible for the accuracy or completeness of any such information or data; and
 2. The cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:
 - a. reviewing and checking all such information and data,
 - b. locating all Underground Facilities shown or indicated in the Contract Documents,
 - c. coordination of the Work with the owners of such Underground Facilities, including Owner, during construction, and

- d. the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

B. Not Shown or Indicated

1. If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated, or not shown or indicated with reasonable accuracy in the Contract Documents, Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer. Engineer will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequences of the existence or location of the Underground Facility. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.
2. If Engineer concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued to reflect and document such consequences. An equitable adjustment shall be made in the Contract Price or Contract Times, or both, to the extent that they are attributable to the existence or location of any Underground Facility that was not shown or indicated or not shown or indicated with reasonable accuracy in the Contract Documents and that Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment in Contract Price or Contract Times, Owner or Contractor may make a Claim therefor as provided in Paragraph 10.05.

4.05 Reference Points

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

4.06 Hazardous Environmental Condition at Site

- A. Reports and Drawings: No reports on drawings related to Hazardous Environmental Conditions are known to the Owner or Engineer.
- B. Limited Reliance by Contractor on Technical Data Authorized: Not used.

PART 5 - BONDS AND INSURANCE

5.01 Performance, Payment, and Other Bonds

- A. Contractor shall furnish performance and payment bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all of Contractor's obligations under the Contract Documents. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 13.07, whichever is later, except as provided otherwise by Laws or Regulations or by the Contract Documents. Contractor shall also furnish such other bonds as are required by the Contract Documents.
- B. All bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All bonds signed by an agent must be accompanied by a certified copy of the agent's authority to act.
- C. If the surety on any bond furnished by Contractor is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of Paragraph 5.01.B, Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the requirements of Paragraphs 5.01.B and 5.02.

5.02 Licensed Sureties and Insurers

- A. All bonds and insurance required by the Contract Documents to be purchased and maintained by Owner or Contractor shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also meet such additional requirements and qualifications.

5.03 Certificates of Insurance

- A. Contractor shall deliver to Owner, with copies to each additional insured, certificates of insurance (and other evidence of insurance requested by Owner or any other additional insured) which Contractor is required to purchase and maintain.
- B. Owner shall deliver to Contractor, with copies to each additional insured, certificates of insurance (and other evidence of insurance requested by Contractor or any other additional insured) which Owner is required to purchase and maintain.
- C. Failure of Owner to demand such certificates or other evidence of full compliance with these insurance requirements or failure of Owner to identify a deficiency from evidence provided shall not be construed as a waiver of Contractor's obligation to maintain such insurance.
- D. By requiring such insurance and insurance limits herein, Owner does not represent that coverage and limits will necessarily be adequate to protect contractor and such coverage and limits shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner in the Contract Documents.

5.04 Contractor's Liability Insurance

- A. Contractor shall purchase and maintain such liability and other insurance as is appropriate for the Work being performed and as will provide protection from claims set forth below which may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable:
1. claims under workers' compensation, disability benefits, and other similar employee benefit acts;
 2. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees;
 3. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees;
 4. claims for damages insured by reasonably available personal injury liability coverage which are sustained:
 - a. by any person as a result of an offense directly or indirectly related to the employment of such person by Contractor, or
 - b. by any other person for any other reason;
 5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and
 6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.
- B. The policies of insurance required by this Paragraph 5.04 shall:
1. with respect to insurance required by Paragraphs 5.04.A.3 through 5.04.A.6 inclusive, include as additional insured (subject to any customary exclusion regarding professional liability) Owner and Engineer, and any other individuals or entities, all of whom shall be listed as additional insureds, and include coverage for the respective officers, directors, partners, employees, agents, consultants and subcontractors of each and any of all such additional insureds, and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby;
 2. include at least the specific coverages and be written for not less than the limits of liability provided or required by Laws or Regulations, whichever is greater;
 3. include completed operations insurance;
 4. include contractual liability insurance covering Contractor's indemnity obligations under Paragraphs 6.11 and 6.20;
 5. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the Contractor pursuant to Paragraph 5.03 will so provide);

6. remain in effect at least until final payment and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work in accordance with Paragraph 13.07; and
 7. with respect to completed operations insurance, and any insurance coverage written on a claims-made basis, remain in effect for at least two years after final payment.
 - a. Contractor shall furnish Owner and each other additional insured to whom a certificate of insurance has been issued, evidence satisfactory to Owner and any such additional insured of continuation of such insurance at final payment and one year thereafter.
- C. The limits of liability for the insurance required by Paragraph 5.04 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:
1. Workers' Compensation, and related coverages under Paragraphs 5.04.A.1 and A.2 of the General Conditions:
 - a. State: South Carolina
Statutory Benefits
 - b. Applicable Federal (e.g., Longshoreman's): Statutory
 - c. Employer's Liability:

Each Accident	\$500,000
Disease-Policy Limit	\$500,000
Disease-Each Employee	\$500,000
 2. Contractor's General Liability under Paragraphs 5.04.A.3 through A.6 of the General Conditions which shall include completed operations and product liability coverages and eliminate the exclusion with respect to property under the care, custody and control of Contractor and for this project only:
 - a. General Aggregate \$2,000,000
 - b. Products - Completed
Operations Aggregate \$2,000,000
 - c. Personal and Advertising
Injury \$1,000,000
 - d. Each Occurrence
(Bodily Injury and
Property Damage) \$1,000,000
 - e. Fire Damage (any one (1) fire) \$50,000
 - f. Medical Expense (any one (1) person) \$5,000
 - g. Property Damage liability insurance will provide Explosion, Collapse, and Under-ground coverages where applicable.

- h. Excess or Umbrella Liability
 - 1) General Aggregate \$2,000,000
 - 2) Each Occurrence \$2,000,000
- 3. Automobile Liability under Paragraph 5.04.A.6 of the General Conditions:
 - a. Include coverage for all owned, hired and non-owned automobiles.
 - b. Combined Single Limit of \$1,000,000
- 4. The Contractual Liability coverage required by Paragraph 5.04.B.4 of the General Conditions shall provide coverage for not less than the following amounts:
 - a. Bodily Injury:
 - Each Accident \$2,000,000
 - Annual Aggregate \$2,000,000
 - b. Property Damage:
 - Each Accident \$2,000,000
 - Annual Aggregate \$2,000,000
- 5. Flood Insurance: The Contractor is required to carry flood insurance for projects located in designated flood hazard areas in which Federal Flood Insurance is available.

5.05 Owner's Liability Insurance

- A. In addition to the insurance required to be provided by Contractor under Paragraph 5.04, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.

5.06 Property Insurance

- A. Contractor shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof.
 - 1. This insurance shall:
 - a. include the interests of Owner, Contractor, Subcontractors, Engineer and any other individuals or entities identified herein, and the officers, directors, partners, employees, agents and other consultants and subcontractors of any of them each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured;
 - b. in addition to the individuals and entities specified, include as additional insureds, the following:
 - c. be written on a Builder's Risk "all-risk" or open peril or special causes of loss policy form that shall at least include insurance for physical loss and damage to the Work, temporary buildings, falsework, and materials and equipment in transit and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage (other than that caused by flood), and such other perils or causes of loss as may be specifically required;

- d. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);
 - e. cover materials and equipment stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by Engineer;
 - f. allow for partial utilization of the Work by Owner;
 - g. include testing and startup; and
 - h. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor and Engineer with 30 days written notice to each other additional insured to whom a certificate of insurance has been issued.
2. Contractor shall be responsible for any deductible or self-insured retention.
3. The policies of insurance required to be purchased and maintained by Contractor in accordance with this Paragraph SC-5.06.A shall comply with the requirements of paragraph 5.06.C of the General Conditions.
- B. Owner shall purchase and maintain such boiler and machinery insurance or additional property insurance as may be required Laws and Regulations which will include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured.
- C. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with Paragraph 5.06 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least thirty (30) days prior written notice has been given to Owner and Contractor and to each other additional insured to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with Paragraph 5.07.
- D. Owner shall not be responsible for purchasing and maintaining any property insurance specified in this Paragraph 5.06 to protect the interests of Contractor, Subcontractors, or others in the Work to the extent of any deductible amounts that are identified. The risk of loss within such identified deductible amount will be borne by Contractor, Subcontractors, or others suffering any such loss, and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.

5.07 Waiver of Rights

- A. Owner and Contractor intend that all policies purchased in accordance with Paragraph 5.06 will protect Owner, Contractor, Subcontractors, and Engineer, and all other individuals or entities identified to be listed as insureds or additional insureds (and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them) in such policies and will provide primary coverage for all losses and damages caused by the perils or causes of loss covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or additional insureds thereunder. Owner and Contractor waive all rights against each other and their respective officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them for all losses and damages caused by, arising out of or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Subcontractors, and Engineer, and all other individuals or entities identified to be listed as insured or additional insured (and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them) under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner as trustee or otherwise payable under any policy so issued.
- B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them for:
1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and
 2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial utilization pursuant to Paragraph 14.05, after Substantial Completion pursuant to Paragraph 14.04, or after final payment pursuant to Paragraph 14.07.
- C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 5.07.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them.

5.08 Receipt and Application of Insurance Proceeds

- A. Any insured loss under the policies of insurance required by Paragraph 5.06 will be adjusted with Owner and made payable to Owner as fiduciary for the insureds, as their interests may appear, subject to the requirements of any applicable mortgage clause and of Paragraph 5.08.B. Owner shall deposit in a separate account any money so received and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof, and the Work and the cost thereof covered by an appropriate Change Order.

- B. Owner as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within 15 days after the occurrence of loss to Owner's exercise of this power. If such objection be made, Owner as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, Owner as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, Owner as fiduciary shall give bond for the proper performance of such duties.

5.09 Acceptance of Bonds and Insurance; Option to Replace

- A. If either Owner or Contractor has any objection to the coverage afforded by or other provisions of the bonds or insurance required to be purchased and maintained by the other party in accordance with Part 5 on the basis of nonconformance with the Contract Documents, the objecting party shall so notify the other party in writing within ten (10) days after receipt of the certificates (or other evidence requested) required by Paragraph 2.01.B. Owner and Contractor shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the bonds and insurance required of such party by the Contract Documents, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent bonds or insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

5.10 Partial Utilization, Acknowledgment of Property Insurer

- A. If Owner finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 14.05, no such use or occupancy shall commence before the insurers providing the property insurance pursuant to Paragraph 5.06 have acknowledged notice thereof and in writing effected any changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy.

PART 6 - CONTRACTOR'S RESPONSIBILITIES

6.01 Supervision and Superintendence

- A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction. Contractor shall not be responsible for the negligence of Owner or Engineer in the design or specification of a specific means, method, technique, sequence, or procedure of construction which is shown or indicated in and expressly required by the Contract Documents.
- B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances. The superintendent will be Contractor's representative at the Site and shall have authority to act on behalf of Contractor. All communications given to or received from the superintendent shall be binding on Contractor.

6.02 Labor; Working Hours

- A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.
- B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours. Contractor will not permit the performance of Work on a Saturday, Sunday, or any legal holiday without Owner's written consent (which will not be unreasonably withheld) given after prior written notice to Engineer.

6.03 Services, Materials, and Equipment

- A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, startup, and completion of the Work.
- B. All materials and equipment incorporated into the Work shall be as specified or, if not specified, shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.
- C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

6.04 Progress Schedule

- A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.07 as it may be adjusted from time to time as provided below.
 - 1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.07) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times. Such adjustments will comply with any provisions of the General Requirements applicable thereto.
 - 2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Part 12. Adjustments in Contract Times may only be made by a Change Order.

6.05 Substitutes and "Or-Equals"

- A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or-equal" item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to Engineer for review under the circumstances described below.

1. "Or-Equal" Items: If in Engineer's sole discretion an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by Engineer as an "or-equal" item, in which case review and approval of the proposed item may, in Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this Paragraph 6.05.A.1, a proposed item of material or equipment will be considered functionally equal to an item so named if:
 - a. in the exercise of reasonable judgment Engineer determines that:
 - 1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;
 - 2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole,
 - 3) it has a proven record of performance and availability of responsive service; and
 - b. Contractor certifies that, if approved and incorporated into the Work:
 - 1) there will be no increase in cost to the Owner or increase in Contract Times, and
 - 2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.
2. Substitute Items
 - a. If in Engineer's sole discretion an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item under Paragraph 6.05.A.1, it will be considered a proposed substitute item.
 - b. Contractor shall submit sufficient information as provided below to allow Engineer to determine that the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. Requests for review of proposed substitute items of material or equipment will not be accepted by Engineer from anyone other than Contractor.
 - c. The requirements for review by Engineer will be as set forth in Paragraph 6.05.A.2.d, as supplemented in the General Requirements and as Engineer may decide is appropriate under the circumstances.
 - d. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:
 - 1) shall certify that the proposed substitute item will:
 - a) perform adequately the functions and achieve the results called for by the general design,
 - b) be similar in substance to that specified, and
 - c) be suited to the same use as that specified;

- 2) will state:
 - a) the extent, if any, to which the use of the proposed substitute item will prejudice Contractor's achievement of Substantial Completion on time;
 - b) whether or not use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item; and
 - c) whether or not incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty;
 - 3) will identify:
 - a) all variations of the proposed substitute item from that specified, and
 - b) available engineering, sales, maintenance, repair, and replacement services;
 - 4) and shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change,
- B. Substitute Construction Methods or Procedures: If a specific means, method, technique, sequence, or procedure of construction is expressly required by the Contract Documents, Contractor may furnish or utilize a substitute means, method, technique, sequence, or procedure of construction approved by Engineer. Contractor shall submit sufficient information to allow Engineer, in Engineer's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The requirements for review by Engineer will be similar to those provided in Paragraph 6.05.A.2.
- C. Engineer's Evaluation: Engineer will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to Paragraphs 6.05.A and 6.05.B. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No "or equal" or substitute will be ordered, installed or utilized until Engineer's review is complete, which will be evidenced by either a Change Order for a substitute or an approved Shop Drawing for an "or-equal." Engineer will advise Contractor in writing of any negative determination.
- D. Special Guarantee: Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.
- E. Engineer's Cost Reimbursement: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor pursuant to Paragraphs 6.05.A.2 and 6.05.B. Whether or not Engineer approves a substitute item so proposed or submitted by Contractor, Contractor shall reimburse Owner for the charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.
- F. Contractor's Expense: Contractor shall provide all data in support of any proposed substitute or "or-equal" at Contractor's expense.

6.06 Concerning Subcontractors, Suppliers, and Others

- A. Contractor shall not employ any Subcontractor, Supplier, or other individual or entity (including those acceptable to Owner as indicated in Paragraph 6.06.B), whether initially or as a replacement, against whom Owner may have reasonable objection. Contractor shall not be required to employ any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against whom Contractor has reasonable objection.
- B. The identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to Owner in advance for acceptance by Owner by a specified date prior to the Effective Date of the Agreement, and if Contractor has submitted a list thereof, Owner's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the Bidding Documents or the Contract Documents) of any such Subcontractor, Supplier, or other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity, and the Contract Price will be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of any right of Owner or Engineer to reject defective Work.
- C. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions. Nothing in the Contract Documents:
 - 1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier or other individual or entity, nor
 - 2. shall anything in the Contract Documents create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.
- D. Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work under a direct or indirect contract with Contractor.
- E. Contractor shall require all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work to communicate with Engineer through Contractor.
- F. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

- G. All Work performed for Contractor by a Subcontractor or Supplier will be pursuant to an appropriate agreement between Contractor and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer. Whenever any such agreement is with a Subcontractor or Supplier who is listed as an additional insured on the property insurance provided in Paragraph 5.06, the agreement between the Contractor and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against Owner, Contractor, and Engineer,, and all other individuals or entities to be listed as insureds or additional insureds (and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them) for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, Contractor will obtain the same.
- H. Owner or Engineer may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor on account of Work performed for Contractor by a particular Subcontractor or Supplier.

6.07 Patent Fees and Royalties

- A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if to the actual knowledge of Owner or Engineer its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.
- B. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

6.08 Permits

- A. Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of opening of Bids, or, if there are no Bids, on the Effective Date of the Agreement. Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

6.09 Laws and Regulations

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

- B. If Contractor performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work. However, it shall not be Contractor's primary responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.
- C. Changes in Laws or Regulations not known at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids) having an effect on the cost or time of performance of the Work shall be the subject of an adjustment in Contract Price or Contract Times. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

6.10 Taxes

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

6.11 Use of Site and Other Areas

- A. Limitation on Use of Site and Other Areas
 - 1. Contractor shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the Site and other areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and other areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof, or of any adjacent land or areas resulting from the performance of the Work.
 - 2. Should any claim be made by any such owner or occupant because of the performance of the Work, Contractor shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law.
 - 3. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused by or based upon Contractor's performance of the Work.
- B. *Removal of Debris During Performance of the Work:* During the progress of the Work Contractor shall keep the Site and other areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.
- C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

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

6.12 Record Documents

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

6.13 Safety and Protection

- A. Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:
1. all persons on the Site or who may be affected by the Work;
 2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
 3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.
- B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify owners of adjacent property and of Underground Facilities and other utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.
- C. All damage, injury, or loss to any property referred to in Paragraph 6.13.A.2 or 6.13.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or , or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).
- D. Contractor's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 14.07.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.14 Safety Representative

- A. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

6.15 Hazard Communication Programs

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

6.16 Emergencies

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

6.17 Shop Drawings and Samples

- A. Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the acceptable Schedule of Submittals (as required by Paragraph 2.07). Each submittal will be identified as Engineer may require.
 - 1. Shop Drawings
 - a. Submit number of copies specified in the General Requirements.
 - b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide and to enable Engineer to review the information for the limited purposes required by Paragraph 6.17.D.
 - 2. Samples: Contractor shall also submit Samples to Engineer for review and approval in accordance with the acceptable schedule of Shop Drawings and Sample submittals.
 - a. Submit number of Samples specified in the Specifications.
 - b. Clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 6.17.D.
- B. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

C. Submittal Procedures

1. Before submitting each Shop Drawing or Sample, Contractor shall have determined and verified:
 - a. all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;
 - b. the suitability of all materials with respect to intended use, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work;
 - c. all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto; and
 - d. shall also have reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents.
2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review and approval of that submittal.
3. With each submittal, Contractor shall give Engineer specific written notice of any variations, that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be both a written communication separate from the Shop Drawing's or Sample Submittal; and, in addition, by a specific notation made on each Shop Drawing or Sample submitted to Engineer for review and approval of each such variation.

D. Engineer's Review

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.
3. Engineer's review and approval shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 6.17.C.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer's review and approval shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 6.17.C.1.

E. Resubmittal Procedures

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.
- F. Contractor shall furnish required submittals with sufficient information and accuracy in order to obtain required approval of an item with no more than three (3) submittals. Engineer will record Engineer's time for reviewing subsequent submittals of Shop Drawings, samples or other items requiring approval and Contractor shall reimburse Owner for Engineer's charges for such time.
- G. In the event that Contractor requests a substitution for a previously approved item, Contractor shall reimburse Owner for Engineer's charges for such time unless the need for such substitution is beyond the control of Contractor.

6.18 Continuing the Work

- A. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by Paragraph 15.04 or as Owner and Contractor may otherwise agree in writing.

6.19 Contractor's General Warranty and Guarantee

- A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its Related Entities shall be entitled to rely on representation of Contractor's warranty and guarantee.
- B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
 1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or
 2. normal wear and tear under normal usage.
- C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:
 1. observations by Engineer;
 2. recommendation by Engineer or payment by Owner of any progress or final payment;
 3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;
 4. use or occupancy of the Work or any part thereof by Owner;
 5. any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of acceptability by Engineer;

6. any inspection, test, or approval by others; or
 7. any correction of defective Work by Owner.
- D. The Contractor's General Warranty and Guarantee shall be for a period of one (1) year after work has been accepted and final payment made to the Contractor. In the case of Water and Wastewater lines, the warranty period will start after acceptance of these lines into the utility provider's system for ownership, operation, and maintenance. The Contractor accepts the transference of all warranties and guarantees to the utility provider owning and operating the new lines.

6.20 Indemnification

- A. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable .
- B. In any and all claims against Owner or Engineer or any of their respective consultants, agents, officers, directors, partners, or employees by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 6.20.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.
- C. The indemnification obligations of Contractor under Paragraph 6.20.A shall not extend to the liability of Engineer and Engineer's officers, directors, partners, employees, agents, consultants and subcontractors arising out of:
1. the preparation or approval of, or the failure to prepare or approve, maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or
 2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

6.21 Delegation of Professional Design Services

- A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable law.
- B. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of Contractor by the Contract Documents,

Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.

- C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.
- D. Pursuant to this Paragraph 6.21, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 6.17.D.1.
- E. Contractor shall not be responsible for the adequacy of the performance or design criteria required by the Contract Documents.

PART 7 - OTHER WORK AT THE SITE

7.01 Related Work at Site

- A. Owner may perform other work related to the Project at the Site with Owner's employees or via other direct contracts therefor, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:
 - 1. written notice thereof will be given to Contractor prior to starting any such other work; and
 - 2. if Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times that should be allowed as a result of such other work, a Claim may be made therefor as provided in Paragraph 10.05.
- B. Contractor shall afford each other contractor who is a party to such a direct contract, each utility owner and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work, and shall properly coordinate the Work with theirs. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering their work and will only cut or alter their work with the written consent of Engineer and the others whose work will be affected. The duties and responsibilities of Contractor under this Paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of Contractor in said direct contracts between Owner and such utility owners and other contractors.
- C. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Part 7, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that

render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

7.02 Coordination

- A. If Owner intends to contract with others for the performance of other work on the Project at the Site, the following will be set forth:
 - 1. the individual or entity who will have authority and responsibility for coordination of the activities among the various contractors will be identified;
 - 2. the specific matters to be covered by such authority and responsibility will be itemized; and
 - 3. the extent of such authority and responsibilities will be provided.
- B. Owner shall have sole authority and responsibility for such coordination.

7.03 Legal Relationships

- A. Paragraphs 7.01.A and 7.02 are not applicable for utilities not under the control of Owner.
- B. Each other direct contract of Owner under Paragraph 7.01.A shall provide that the other contractor is liable to Owner and Contractor for the reasonable direct delay and disruption costs incurred by Contractor as a result of the other contractor's actions or inactions.
- C. Contractor shall be liable to Owner and any other contractor for the reasonable direct delay and disruption costs incurred by such other contractor as a result of Contractor's action or inactions.

7.04 Claims Between Contractors

- A. Should Contractor cause damage to the work or property of any other contractor at the Site, or should any claim arising out of Contractor's performance of the Work at the Site be made by any other contractor against Contractor, Owner, Engineer, or the construction coordinator, Contractor shall promptly attempt to settle with such other contractor by agreement, or to otherwise resolve the dispute by arbitration or at law.

- B. Contractor shall, to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner, Engineer, the construction coordinator and the officers, directors, partners, employees, agents and other consultants and subcontractors of each and any of them from and against all claims, costs, losses and damages (including, but not limited to, fees and charges of engineers, architects, attorneys, and other professionals and court and arbitration costs) arising directly, indirectly or consequentially out of any action, legal or equitable, brought by any other contractor against Owner, Engineer, Engineer's Consultants, or the construction coordinator to the extent said claim is based on or arises out of Contractor's performance of the Work. Should another contractor cause damage to the Work or property of Contractor or should the performance of work by any other contractor at the Site give rise to any other Claim, Contractor shall not institute any action, legal or equitable, against Owner, Engineer, or the construction coordinator or permit any action against any of them to be maintained and continued in its name or for its benefit in any court or before any arbiter which seeks to impose liability on or to recover damages from Owner, Engineer, or the construction coordinator on account of any such damage or Claim.
- C. If Contractor is delayed at any time in performing or furnishing Work by any act or neglect of another contractor, and Owner and Contractor are unable to agree as to the extent of any adjustment in Contract Times attributable thereto, Contractor may make a Claim for an extension of times in accordance with Part 12. An extension of the Contract Times shall be Contractor's exclusive remedy with respect to Owner, Engineer, and construction coordinator for any delay, disruption, interference, or hindrance caused by any other contractor. This paragraph does not prevent recovery from Owner, Engineer, or construction coordinator for activities that are their respective responsibilities.

PART 8 - OWNER'S RESPONSIBILITIES

8.01 Communications to Contractor

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

8.02 Replacement of Engineer

- A. In case of termination of the employment of Engineer, Owner shall appoint an engineer to whom Contractor makes no reasonable objection, whose status under the Contract Documents shall be that of the former Engineer.

8.03 Furnish Data

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

8.04 Pay When Due

- A. Owner shall make payments to Contractor when they are due as provided in Paragraphs 14.02.C and 14.07.C.

8.05 Lands and Easements; Reports and Tests

- A. Owner's duties in respect of providing lands and easements and providing engineering surveys to establish reference points are set forth in Paragraphs 4.01 and 4.05. Paragraph 4.02 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of subsurface conditions and drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site that have been utilized by Engineer in preparing the Contract Documents.

8.06 Insurance

- A. Owner's responsibilities, if any, in respect to purchasing and maintaining liability and property insurance are set forth in Part 5.

8.07 Change Orders

- A. Owner is obligated to execute Change Orders as indicated in Paragraph 10.03.

8.08 Inspections, Tests, and Approvals

- A. Owner's responsibility in respect to certain inspections, tests, and approvals is set forth in Paragraph 13.03.B.

8.09 Limitations on Owner's Responsibilities

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

8.10 Undisclosed Hazardous Environmental Condition

- A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 4.06.

8.11 Evidence of Financial Arrangements

- A. If and to the extent Owner has agreed to furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents, Owner's responsibility in respect thereof will be as set forth.
- B. On request of Contractor prior to the execution of any Change Order involving a significant increase in the Contract Price, Owner shall furnish to Contractor reasonable evidence that adequate financial arrangements have been made by Owner to enable Owner to fulfill the increased financial obligations to be undertaken by Owner as a result of such Change Order.

PART 9 - ENGINEER'S STATUS DURING CONSTRUCTION

9.01 Owner's Representative

- A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract Documents and will not be changed without written consent of Owner and Engineer.

9.02 Visits to Site

- A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.
- B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 9.09. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

9.03 Project Representative

- A. If Owner and Engineer agree, Engineer will furnish a Resident Project Representative to assist Engineer in providing more extensive observation of the Work. The authority and responsibilities of any such Resident Project Representative and assistants will be as provided, and limitations on the responsibilities thereof will be as provided in Paragraph 9.09. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in Paragraph 9.09.

9.04 Authorized Variations in Work

- A. Engineer may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. These may be accomplished by a Field Order and will be binding on Owner and also on Contractor, who shall perform the Work involved promptly. If Owner or Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, and the parties are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

9.05 Rejecting Defective Work

- A. Engineer will have authority to reject Work which Engineer believes to be defective, or that Engineer believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Engineer will also have authority to require special inspection or testing of the Work as provided in Paragraph 13.04, whether or not the Work is fabricated, installed, or completed.

9.06 Shop Drawings, Change Orders and Payments

- A. In connection with Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, see Paragraph 6.17.
- B. In connection with Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, see Paragraph 6.21.
- C. In connection with Engineer's authority as to Change Orders, see Parts 10, 11, and 12.
- D. In connection with Engineer's authority as to Applications for Payment, see Part 14.

9.07 Determinations for Unit Price Work

- A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of Paragraph 10.05.

9.08 Decisions on Requirements of Contract Documents and Acceptability of Work

- A. Engineer will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. All matters in question and other matters between Owner and Contractor arising prior to the date final payment is due relating to the acceptability of the Work, and the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, will be referred initially to Engineer in writing within 30 days of the event giving rise to the question
- B. Engineer will, with reasonable promptness, render a written decision on the issue referred. If Owner or Contractor believe that any such decision entitles them to an adjustment in the Contract Price or Contract Times or both, a Claim may be made under Paragraph 10.05. The date of Engineer's decision shall be the date of the event giving rise to the issues referenced for the purposes of Paragraph 10.05.B.
- C. Engineer's written decision on the issue referred will be final and binding on Owner and Contractor, subject to the provisions of Paragraph 10.05.
- D. When functioning as interpreter and judge under this Paragraph 9.08, Engineer will not show partiality to Owner or Contractor and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity.

9.09 Limitations on Engineer's Authority and Responsibilities

- A. Neither Engineer's authority or responsibility under this Part 9 or under any other provision of the Contract Documents nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

- B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.
- C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.
- D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 14.07.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals that the results certified indicate compliance with the Contract Documents.
- E. The limitations upon authority and responsibility set forth in this Paragraph 9.09 shall also apply to, the Resident Project Representative, if any, and assistants, if any.

PART 10 - CHANGES IN THE WORK; CLAIMS

10.01 Authorized Changes in the Work

- A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work by a Change Order, or a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).
- B. If Owner and Contractor are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a Work Change Directive, a Claim may be made therefor as provided in Paragraph 10.05.

10.02 Unauthorized Changes in the Work

- A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents as amended, modified, or supplemented as provided in Paragraph 3.04, except in the case of an emergency as provided in Paragraph 6.16 or in the case of uncovering Work as provided in Paragraph 13.04.B.

10.03 Execution of Change Orders

- A. Owner and Contractor shall execute appropriate Change Orders recommended by Engineer covering:
 - 1. changes in the Work which are: (i) ordered by Owner pursuant to Paragraph 10.01.A, (ii) required because of acceptance of defective Work under Paragraph 13.08.A or Owner's correction of defective Work under Paragraph 13.09, or (iii) agreed to by the parties;
 - 2. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive; and

3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by Engineer pursuant to Paragraph 10.05; provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, Contractor shall carry on the Work and adhere to the Progress Schedule as provided in Paragraph 6.18.A.

10.04 Notification to Surety

- A. If notice of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times) is required by the provisions of any bond to be given to a surety, the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

10.05 Claims

- A. Engineer's Decision Required: All Claims, except those waived pursuant to Paragraph 14.09, shall be referred to the Engineer for decision. A decision by Engineer shall be required as a condition precedent to any exercise by Owner or Contractor of any rights or remedies either may otherwise have under the Contract Documents or by Laws and Regulations in respect of such Claims.
- B. Notice: Written notice stating the general nature of each Claim shall be delivered by the claimant to Engineer and the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto. The responsibility to substantiate a Claim shall rest with the party making the Claim. Notice of the amount or extent of the Claim, with supporting data shall be delivered to the Engineer and the other party to the Contract within 60 days after the start of such event (unless Engineer allows additional time for claimant to submit additional or more accurate data in support of such Claim). A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of Paragraph 12.01.B. A Claim for an adjustment in Contract Time shall be prepared in accordance with the provisions of Paragraph 12.02.B. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it is entitled as a result of said event. The opposing party shall submit any response to Engineer and the claimant within 30 days after receipt of the claimant's last submittal (unless Engineer allows additional time).
- C. Engineer's Action: Engineer will review each Claim and, within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any, take one of the following actions in writing:
 1. deny the Claim in whole or in part,
 2. approve the Claim, or
 3. notify the parties that the Engineer is unable to resolve the Claim if, in the Engineer's sole discretion, it would be inappropriate for the Engineer to do so. For purposes of further resolution of the Claim, such notice shall be deemed a denial.
- D. In the event that Engineer does not take action on a Claim within said 30 days, the Claim shall be deemed denied.

- E. Engineer's written action under Paragraph 10.05.C or denial pursuant to Paragraphs 10.05.C.3 or 10.05.D will be final and binding upon Owner and Contractor, unless Owner or Contractor invoke the dispute resolution procedure set forth in Part 16 within 30 days of such action or denial.
- F. No Claim for an adjustment in Contract Price or Contract Times will be valid if not submitted in accordance with this Paragraph 10.05.

PART 11 - COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

11.01 Cost of the Work

- A. Costs Included: The term Cost of the Work means the sum of all costs, except those excluded in Paragraph 11.01.B, necessarily incurred and paid by Contractor in the proper performance of the Work. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, the costs to be reimbursed to Contractor will be only those additional or incremental costs required because of the change in the Work or because of the event giving rise to the Claim. Except as otherwise may be agreed to in writing by Owner, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall include only the following items, and shall not include any of the costs itemized in Paragraph 11.01.B.
 - 1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time at the Site. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.
 - 2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.
 - 3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 11.01.
 - 4. Costs of special consultants (including but not limited to Engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.

5. Supplemental costs including the following:

- a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.
- b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.
- c. Rentals of all construction equipment and machinery, and the parts thereof whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.
- d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, imposed by Laws and Regulations.
- e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
- f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 5.06.D), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.
- g. The cost of utilities, fuel, and sanitary facilities at the Site.
- h. Minor expenses such as telegrams, long distance telephone calls, telephone service at the Site, expresses, and similar petty cash items in connection with the Work.
- i. The costs of premiums for all bonds and insurance Contractor is required by the Contract Documents to purchase and maintain.

B. Costs Excluded: The term Cost of the Work shall not include any of the following items:

1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 11.01.A.1 or specifically covered by Paragraph 11.01.A.4, all of which are to be considered administrative costs covered by the Contractor's fee.
 2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
 3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
 4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.
 5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraphs 11.01.A and 11.01.B.
- C. Contractor's Fee: When all the Work is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 12.01.C.
- D. Documentation: Whenever the Cost of the Work for any purpose is to be determined pursuant to Paragraphs 11.01.A and 11.01.B, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

11.02 Allowances

- A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.
- B. Cash Allowances
1. Contractor agrees that:
 - a. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and
 - b. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.

C. Contingency Allowance

1. Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.
- D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

11.03 Unit Price Work

- A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.
- B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by Contractor will be made by Engineer subject to the provisions of Paragraph 9.07.
- C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.
- D. Owner or Contractor may make a Claim for an adjustment in the Contract Price in accordance with Paragraph 10.05 if:
1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and
 2. there is no corresponding adjustment with respect any other item of Work; and
 3. Contractor believes that Contractor is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease.

PART 12 - CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES

12.01 Change of Contract Price

- A. The Contract Price may only be changed by a Change Order. Any Claim for an adjustment in the Contract Price shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05. Final approval of all change orders rests with the owner.
- B. The value of any Work covered by a Change Order or of any Claim for an adjustment in the Contract Price will be determined as follows:
1. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 11.03); or

2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 12.01.C.2); or
 3. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under Paragraph 12.01.B.2, on the basis of the Cost of the Work (determined as provided in Paragraph 11.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 12.01.C).
- C. Contractor's Fee: The Contractor's fee for overhead and profit shall be determined as follows:
1. a mutually acceptable fixed fee; or
 2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
 - a. for costs incurred under Paragraphs 11.01.A.1 and 11.01.A.2, the Contractor's fee shall be 15 percent;
 - b. for costs incurred under Paragraph 11.01.A.3, the Contractor's fee shall be five percent;
 - c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraph 12.01.C.2.a is that the Subcontractor who actually performs the Work, at whatever tier, will be paid a fee of 15 percent of the costs incurred by such Subcontractor under Paragraphs 11.01.A.1 and 11.01.A.2 and that any higher tier Subcontractor and Contractor will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor;
 - d. no fee shall be payable on the basis of costs itemized under Paragraphs 11.01.A.4, 11.01.A.5, and 11.01.B;
 - e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and
 - f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 12.01.C.2.a through 12.01.C.2.e, inclusive.

12.02 Change of Contract Times

- A. The Contract Times may only be changed by a Change Order. Any Claim for an adjustment in the Contract Times shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05. Final approval of all change orders rests with the owner.
- B. Any adjustment of the Contract Times covered by a Change Order or any Claim for an adjustment in the Contract Times will be determined in accordance with the provisions of this Part 12.

12.03 Delays

- A. Where Contractor is prevented from completing any part of the Work within the Contract Times due to delay beyond the control of Contractor, the Contract Times will be extended in an amount equal to the time lost due to such delay if a Claim is made therefor as provided in Paragraph 12.02.A. Delays beyond the control of Contractor shall include, but not be limited to, acts or neglect by Owner, acts or neglect of utility owners or other contractors performing other work as contemplated by Part 7, fires, floods, epidemics, abnormal weather conditions, or acts of God.
- B. If Owner, Engineer, or other contractors or utility owners performing other work for Owner as contemplated by Part 7, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times , or both. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
- C. If Contractor is delayed in the performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of God, acts or failures to act of utility owners not under the control of Owner, or other causes not the fault of and beyond control of Owner and Contractor, then Contractor shall be entitled to an equitable adjustment in Contract Times, if such adjustment is essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays described in this Paragraph 12.03.C.
- D. Owner, Engineer and the Related Entities of each of them shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of Engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.
- E. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delays within the control of Contractor. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor.
- F. All claims for delays shall be submitted within thirty (30) days of the event causing the delay.

PART 13 - TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

13.01 Notice of Defects

- A. Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor. All defective Work may be rejected, corrected, or accepted as provided in this Part 13.

13.02 Access to Work

- A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and governmental agencies with jurisdictional interests will have access to the Site and the Work at reasonable times for their observation, inspecting, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's Site safety procedures and programs so that they may comply therewith as applicable.

13.03 Tests and Inspections

- A. Contractor shall give Engineer timely notice of readiness of the Work for all required inspections, tests, or approvals and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.
- B. Owner shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:
 - 1. for inspections, tests, or approvals covered by Paragraphs 13.03.C and 13.03.D below;
 - 2. that costs incurred in connection with tests or inspections conducted pursuant to Paragraph 13.04.B shall be paid as provided in said Paragraph 13.04.C; and
 - 3. as otherwise specifically provided in the Contract Documents.
- C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.
- D. Contractor shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to Owner and Engineer.
- E. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, it must, if requested by Engineer, be uncovered for observation.
- F. Uncovering Work as provided in Paragraph 13.03.E shall be at Contractor's expense unless Contractor has given Engineer timely notice of Contractor's intention to cover the same and Engineer has not acted with reasonable promptness in response to such notice.

13.04 Uncovering Work

- A. If any Work is covered contrary to the written request of Engineer, it must, if requested by Engineer, be uncovered for Engineer's observation and replaced at Contractor's expense.
- B. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, furnishing all necessary labor, material, and equipment.
- C. If it is found that the uncovered Work is defective, Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05.

- D. If, the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

13.05 Owner May Stop the Work

- A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

13.06 Correction or Removal of Defective Work

- A. Promptly after receipt of notice, Contractor shall correct all defective Work, whether or not fabricated, installed, or completed, or, if the Work has been rejected by Engineer, remove it from the Project and replace it with Work that is not defective. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or removal (including but not limited to all costs of repair or replacement of work of others).
- B. When correcting defective Work under the terms of this Paragraph 13.06 or Paragraph 13.07, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

13.07 Correction Period

- A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents) or by any specific provision of the Contract Documents, any Work is found to be defective, or if the repair of any damages to the land or areas made available for Contractor's use by Owner or permitted by Laws and Regulations as contemplated in Paragraph 6.11.A is found to be defective, Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:
1. repair such defective land or areas; or
 2. correct such defective Work; or
 3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and
 4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or other land or areas resulting therefrom.

- B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by Contractor.
- C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.
- D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this Paragraph 13.07, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.
- E. Contractor's obligations under this Paragraph 13.07 are in addition to any other obligation or warranty. The provisions of this Paragraph 13.07 shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitation or repose.

13.08 Acceptance of Defective Work

- A. If, instead of requiring correction or removal and replacement of defective Work, Owner (and, prior to Engineer's recommendation of final payment, Engineer) prefers to accept it, Owner may do so. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness) and the diminished value of the Work to the extent not otherwise paid by Contractor pursuant to this sentence. If any such acceptance occurs prior to Engineer's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work, and Owner shall be entitled to an appropriate decrease in the Contract Price, reflecting the diminished value of Work so accepted. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05. If the acceptance occurs after such recommendation, an appropriate amount will be paid by Contractor to Owner.

13.09 Owner May Correct Defective Work

- A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work or to remove and replace rejected Work as required by Engineer in accordance with Paragraph 13.06.A, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, Owner may, after seven (7) days written notice to Contractor, correct or remedy any such deficiency.

- B. In exercising the rights and remedies under this Paragraph 13.09, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, take possession of Contractor's tools, appliances, construction equipment and machinery at the Site, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this Paragraph.
- C. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 13.09 will be charged against Contractor, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount of the adjustment, Owner may make a Claim therefor as provided in Paragraph 10.05. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.
- D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 13.09.

PART 14 - PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 Schedule of Values

- A. The Schedule of Values established as provided in Paragraph 2.07.A will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed.

14.02 Progress Payments

- A. Applications for Payments
 - 1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. The date of the pay application must be the last day of the month. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens and evidence that the materials and equipment are covered by appropriate property insurance or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.
3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

B. Review of Applications

1. Engineer will, within fifteen (15) days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to Owner or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.
2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations on the Site of the executed Work as an experienced and qualified design professional and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:
 - a. the Work has progressed to the point indicated;
 - b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, to the results of any subsequent tests called for in the Contract Documents, to a final determination of quantities and classifications for Unit Price Work under Paragraph 9.07, and to any other qualifications stated in the recommendation); and
 - c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.
3. By recommending any such payment Engineer will not thereby be deemed to have represented that:
 - a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract Documents; or
 - b. that there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.
4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:
 - a. to supervise, direct, or control the Work, or
 - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or

- c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or
 - d. to make any examination to ascertain how or for what purposes Contractor has used the moneys paid on account of the Contract Price, or
 - e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.
5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 14.02.B.2. Engineer may also refuse to recommend any such payment or, because of subsequently discovered evidence or the results of subsequent inspections or tests, revise or revoke any such payment recommendation previously made, to such extent as may be necessary in Engineer's opinion to protect Owner from loss because:
- a. the Work is defective, or completed Work has been damaged, requiring correction or replacement;
 - b. the Contract Price has been reduced by Change Orders;
 - c. Owner has been required to correct defective Work or complete Work in accordance with Paragraph 13.09; or
 - d. Engineer has actual knowledge of the occurrence of any of the events enumerated in Paragraph 15.02.A.

C. Payment Becomes Due

1. Fifteen (15) days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended will (subject to the provisions of Paragraph 14.02.D) become due, and when due will be paid by Owner to Contractor.

D. Reduction in Payment

1. Owner may refuse to make payment of the full amount recommended by Engineer because:
- a. claims have been made against Owner on account of Contractor's performance or furnishing of the Work;
 - b. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;
 - c. there are other items entitling Owner to a set-off against the amount recommended; or
 - d. Owner has actual knowledge of the occurrence of any of the events enumerated in Paragraphs 14.02.B.5.a through 14.02.B.5.c or Paragraph 15.02.A.

2. If Owner refuses to make payment of the full amount recommended by Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, when Contractor corrects to Owner's satisfaction the reasons for such action.
3. If it is subsequently determined that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 14.02.C.1.

14.03 Contractor's Warranty of Title

- A. Contractor warrants and guarantees that title to all Work, materials, and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to Owner no later than the time of payment free and clear of all Liens.

14.04 Substantial Completion

- A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete (except for items specifically listed by Contractor as incomplete) and request that Engineer issue a certificate of Substantial Completion.
- B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.
- C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment. Owner shall have seven (7) days after receipt of the tentative certificate during which to make written objection to Engineer as to any provisions of the certificate or attached list. If, after considering such objections, Engineer concludes that the Work is not substantially complete, Engineer will within 14 days after submission of the tentative certificate to Owner notify Contractor in writing, stating the reasons therefor. If, after consideration of Owner's objections, Engineer considers the Work substantially complete, Engineer will within said 14 days execute and deliver to Owner and Contractor a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as Engineer believes justified after consideration of any objections from Owner.
- D. At the time of delivery of the tentative certificate of Substantial Completion, Engineer will deliver to Owner and Contractor a written recommendation as to division of responsibilities pending final payment between Owner and Contractor with respect to security, operation, safety, and protection of the Work, maintenance, heat, utilities, insurance, and warranties and guarantees. Unless Owner and Contractor agree otherwise in writing and so inform Engineer in writing prior to Engineer's issuing the definitive certificate of Substantial Completion, Engineer's aforesaid recommendation will be binding on Owner and Contractor until final payment.
- E. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to complete or correct items on the tentative list.

14.05 Partial Utilization

- A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions.
1. Owner at any time may request Contractor in writing to permit Owner to use or occupy any such part of the Work which Owner believes to be ready for its intended use and substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor will certify to Owner and Engineer that such part of the Work is substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.
 2. Contractor at any time may notify Owner and Engineer in writing that Contractor considers any such part of the Work ready for its intended use and substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.
 3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 14.04 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.
 4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 5.10 regarding property insurance.

14.06 Final Inspection

- A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

14.07 Final Payment

- A. Application for Payment
1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance certificates of inspection, marked-up record documents (as provided in Paragraph 6.12), and other documents, Contractor may make application for final payment following the procedure for progress payments.
 2. The final Application for Payment shall be accompanied (except as previously delivered) by:
 - a. all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by Paragraph 5.04.B.7;

- b. consent of the surety, if any, to final payment;
 - c. a list of all Claims against Owner that Contractor believes are unsettled; and
 - d. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of or Liens filed in connection with the Work.
3. In lieu of the releases or waivers of Liens specified in Paragraph 14.07.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (i) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (ii) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner or Owner's property might in any way be responsible have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien.
- B. Engineer's Review of Application and Acceptance**
1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract Documents have been fulfilled, Engineer will, within ten (10) days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of payment and present the Application for Payment to Owner for payment. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable subject to the provisions of Paragraph 14.09. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.
- C. Payment Becomes Due**
1. Thirty (30) days after the presentation to Owner of the Application for Payment and accompanying documentation, the amount recommended by Engineer, less any sum Owner is entitled to set off against Engineer's recommendation, including but not limited to liquidated damages, will become due and , will be paid by Owner to Contractor.

14.08 Final Completion Delayed

- A. If, through no fault of Contractor, final completion of the Work is significantly delayed, and if Engineer so confirms, Owner shall, upon receipt of Contractor's final Application for Payment (for Work fully completed and accepted) and recommendation of Engineer, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by Owner for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if bonds have been furnished as required in Paragraph 5.01, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by Contractor to Engineer with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

14.09 Waiver of Claims

- A. The making and acceptance of final payment will constitute:
1. a waiver of all Claims by Owner against Contractor, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 14.06, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Contractor's continuing obligations under the Contract Documents; and
 2. a waiver of all Claims by Contractor against Owner other than those previously made in accordance with the requirements herein and expressly acknowledged by Owner in writing as still unsettled.

PART 15 - SUSPENSION OF WORK AND TERMINATION

15.01 Owner May Suspend Work

- A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by notice in writing to Contractor and Engineer which will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be granted an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if Contractor makes a Claim therefor as provided in Paragraph 10.05.

15.02 Owner May Terminate for Cause

- A. The occurrence of any one or more of the following events will justify termination for cause:
1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule established under Paragraph 2.07 as adjusted from time to time pursuant to Paragraph 6.04);
 2. Contractor's disregard of Laws or Regulations of any public body having jurisdiction;
 3. Contractor's disregard of the authority of Engineer; or
 4. Contractor's violation in any substantial way of any provisions of the Contract Documents.
- B. If one or more of the events identified in Paragraph 15.02.A occur, Owner may, after giving Contractor (and surety) seven (7) days written notice of its intent to terminate the services of Contractor:
1. exclude Contractor from the Site, and take possession of the Work and of all Contractor's tools, appliances, construction equipment, and machinery at the Site, and use the same to the full extent they could be used by Contractor (without liability to Contractor for trespass or conversion),
 2. incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and
 3. complete the Work as Owner may deem expedient.

- C. If Owner proceeds as provided in Paragraph 15.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Owner arising out of or relating to completing the Work, such excess will be paid to Contractor. If such claims, costs, losses, and damages exceed such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this Paragraph Owner shall not be required to obtain the lowest price for the Work performed.
- D. Notwithstanding Paragraphs 15.02.B and 15.02.C, Contractor's services will not be terminated if Contractor begins within seven (7) days of receipt of notice of intent to terminate to correct its failure to perform and proceeds diligently to cure such failure within no more than 30 days of receipt of said notice.
- E. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue. Any retention or payment of moneys due Contractor by Owner will not release Contractor from liability.
- F. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 5.01.A, the termination procedures of that bond shall supersede the provisions of Paragraphs 15.02.B, and 15.02.C.

15.03 Owner May Terminate For Convenience

- A. Upon seven (7) days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):
 - 1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;
 - 2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;
 - 3. all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred in settlement of terminated contracts with Subcontractors, Suppliers, and others; and
 - 4. reasonable expenses directly attributable to termination.
- B. Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

15.04 Contractor May Stop Work or Terminate

- A. If, through no act or fault of Contractor, (i) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (ii) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (iii) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven (7) days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the Contract and recover from Owner payment on the same terms as provided in Paragraph 15.03.
- B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven (7) days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this Paragraph 15.04 are not intended to preclude Contractor from making a Claim under Paragraph 10.05 for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this Paragraph.

PART 16 - DISPUTE RESOLUTION

16.01 Methods and Procedures

- A. Either Owner or Contractor may request mediation of any Claim submitted to Engineer for a decision under Paragraph 10.05 before such decision becomes final and binding. The mediation will be governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of the Agreement. The request for mediation shall be submitted in writing to the American Arbitration Association and the other party to the Contract. Timely submission of the request shall stay the effect of Paragraph 10.05.E.
- B. Owner and Contractor shall participate in the mediation process in good faith. The process shall be concluded within 60 days of filing of the request. The date of termination of the mediation shall be determined by application of the mediation rules referenced above.
- C. If the Claim is not resolved by mediation, Engineer's action under Paragraph 10.05.C or a denial pursuant to Paragraphs 10.05.C.3 or 10.05.D shall become final and binding 30 days after termination of the mediation unless, within that time period, Owner or Contractor:
 - 1. elects in writing to invoke any dispute resolution process, or
 - 2. agrees with the other party to submit the Claim to another dispute resolution process, or
 - 3. gives written notice to the other party of their intent to submit the Claim to a court of competent jurisdiction.

PART 17 - MISCELLANEOUS

17.01 Giving Notice

- A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:
 - 1. delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or
 - 2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

17.02 Computation of Times

- A. When any period of time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

17.03 Cumulative Remedies

- A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract Documents. The provisions of this Paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

17.04 Survival of Obligations

- A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

17.05 Controlling Law

- A. This Contract is to be governed by the law of the state in which the Project is located.

17.06 Headings

- A. Part and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

END OF SECTION

SECTION 01 06 00

REGULATORY REQUIREMENTS

PART 1 GENERAL

1.01 DESCRIPTION

- A. The following requirements of Regulatory Agencies having jurisdiction within this project area are considered a part of these Contract Documents.
- B. The project construction, including the letting of contracts, shall conform to any applicable requirements of the State, territorial and local laws and/or ordinances provided that these requirements do not conflict with any Federal laws and this sub-chapter.
- C. South Carolina Sales Tax: All applicable South Carolina sales tax shall be paid by the Contractor.
 - a. Use of chemicals: All chemicals used during the project construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer, reactant or of other classification, must show approval of EPA or USDA. Use of all such chemicals and disposal of residues shall be in strict conformance with manufacturer's instructions.
- D. Safety and Health Regulations: The Contractor shall comply with the Department of Labor Safety and Health Regulations for construction promulgated under the Occupational Safety and Health Act of 1970 (PL 91-596) and under Section 107 of the Contract Work Hours and Safety Standards Act (PL 91-54).

1.02 INSPECTION BY AGENCIES:

- A. The representatives of the South Carolina Department of Health and Environmental Control, County of Clarendon, Environmental Protection Agency, and if required, the U.S. Army Corps of Engineers shall have access to the work wherever it is, in preparation or in progress, and the Contractor shall provide proper facilities for such access and inspection.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 23 00

BID ALTERNATES AND SUBSTITUTES

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes administrative and procedural requirements for alternates.

1.02 DEFINITIONS

- A. Bid Alternate: A scope of work proposed by the Bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to or deducted from the Base Bid amount if Owner decides to accept corresponding changes either in the amount of construction to be completed, or in the products, materials, equipment, systems or installation methods described in the Contract Documents. The selection of the successful bidder will be based on the Base Bid amount which does not include Alternate Bid Items.
 - 1. The cost or credit for each alternate is the net addition or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum related to this Definition.
- B. Base Bid: The amount for which the Bidder proposes to perform Work, not including that work for which Alternative Bid items and Substitutes are also submitted.

1.03 PROCEDURES

- A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate or substitute into the Project.
 - 1. Include as part of each Alternate or Substitute, miscellaneous devices, accessory objects and similar items incidental to or required for a complete installation whether or not indicated as part of the alternate.
- B. Notification: Following award of the Contract, Engineer shall notify each party involved, in writing, of the status of each alternate or Substitute equipment. Engineer shall indicate if alternates and substitutes have been accepted, rejected, or deferred for later consideration. Where applicable, Contractor shall include a complete description of negotiated modifications to alternates or Substitutes offered.
- C. Execute accepted alternates under the same conditions as other work of the Contract.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 SCHEDULE OF ALTERNATIVES

- A. There are no Bid Alternates a part of this Contract.

END OF SECTION

SECTION 01 30 00

ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preconstruction meeting.
- B. Progress meetings
- C. Construction progress schedule
- D. Submittals for review, information and project closeout
- E. Number of copies of submittals
- F. Submittal procedures

1.02 RELATED SECTIONS

- A. Document 00 70 00 - General Conditions: Dates for applications for payment
- B. Document 00 70 00 - General Conditions: Duties of the Construction Manager
- C. Section 01 32 16 - Construction Progress Schedule: Form, content and administration of schedules
- D. Section 01 70 00 - Execution and Closeout Requirements: Additional coordination requirements
- E. Section 01 78 00 - Closeout Submittals: Project record documents
- F. Sections throughout these specifications may include other submittals that may be required for construction

1.03 PROJECT COORDINATION

- A. Project Manager: Alliance Consulting Engineers, Inc. designee.
- B. Coordinate with the Project Manager on the site for allocation of mobilization areas; for field offices and sheds, for access, traffic and parking facilities.
- C. During construction, coordinate use of site and facilities through the Project Manager.
- D. Comply with Project Manager's procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.
- E. Make the following types of submittals to the Project Manager:
 - 1. Requests for interpretation.
 - 2. Requests for substitution.

3. Shop drawings, operation and maintenance manuals, product data, and samples.
4. Manufacturer's instructions and field reports.
5. Applications for payment and change order requests.
6. Progress schedules.
7. Coordination drawings.
8. Closeout submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRECONSTRUCTION MEETING

- A. Engineer will schedule a meeting within thirty (30) days after the Owner has determined the low bidder and may be held prior to issuance of the Notice to Proceed when required by regulatory agencies having jurisdiction. In any event, the Meeting will be held prior to actual start of construction.
- B. For the individuals designated by the Contractor, their subcontractors and suppliers attending the Preconstruction Meeting, provide required authority to commit the entities they represent to solutions agreed upon in the meeting.
- C. Advise the Engineer at least twenty-hours (24) in advance of the meeting to add items to the agenda.
- D. Attendance Required:
 1. Owner.
 2. Engineer.
 3. Contractor.
 4. Subcontractors, as needed.
 5. Utility Providers
 6. Permit Agents
- E. Agenda:
 1. Execution of Owner-Contractor Contract Agreement.
 2. Distribution of Contract Documents.
 3. Arrangement of Contractor's forces and personnel and those of subcontractors, material suppliers and the Engineer.
 4. Channels and procedures for communication.
 5. Designation of personnel representing the parties to Contract, Contractor, Owner

and Engineer.

6. Procedures and processing of field decisions, submittals and substitutions, applications for payments, proposal request, Change Orders and Contract closeout procedures.
 7. Scheduling.
 8. Scheduling activities of a Geotechnical Engineer
 9. Rules and regulations governing performance of the Work for security, quality control, housekeeping and related matters.
- F. Preconstruction Meeting minutes will be recorded and distributed within ten (10) days after meeting to participants, with three (3) copies to the Contractor and the required number of copies to the Owner, and those affected by decisions being made.

3.02 PROGRESS MEETINGS

- A. Engineer will make arrangements for meetings, prepare agenda with copies for participants, and preside at meetings. Contractor must advise the Engineer within forty-eight (48) hours of advance notice of the meeting to add items to the agenda.
- B. The Contractor's relations with their subcontractors and material suppliers, and discussions with regards to these items are the Contractor's responsibility and normally not part of the project meeting agenda.
- C. For the individuals designated by the Contractor to attend and participate in the project meetings, provide required authority to commit the Contractor to solutions agreed upon in the project meetings.
- D. Attendance Required: Job superintendent, major Subcontractors and suppliers, Owner, Engineer, as appropriate to agenda topics for each meeting.
- E. Meeting Schedule:
 1. Project Meetings will be held monthly or as determined by the Engineer and Owner during construction.
 2. Coordinate as necessary to establish mutually acceptable schedule for meetings.
- F. Meeting Location: The Engineer will establish the meeting location, and where possible the meetings will be held at the project site or a location near the project site.
- G. Agenda:
 1. Review minutes of previous meetings.
 2. Review of Work progress.
 3. Field observations, problems, and decisions.
 4. Identification of problems that impede, or will impede, planned progress.
 5. Review of submittals schedule and status of submittals.

6. Maintenance of progress schedule.
 7. Corrective measures to regain projected schedules
 8. Planned progress during succeeding work period.
 9. Maintenance of quality and work standards.
 10. Effect of proposed changes on progress schedule and coordination.
 11. Other business relating to Work.
- H. Project Meeting minutes will be recorded and distributed within ten (10) days after meeting to participants, with three (3) copies to the Contractor and the required number of copies to the Owner, and those affected by decisions made.
- I. Revisions to Meeting Minutes:
1. Unless published minutes are challenged in writing prior to the next regularly scheduled progress meeting, the minutes will be accepted as properly stating the activities and decisions of the meeting.
 2. Individuals challenging published minutes shall reproduce and distribute copies of the challenge for review by all parties affected.
 3. Challenge to minutes shall be settled as priority portion of "old business" at the next regularly scheduled meeting.

3.03 CONSTRUCTION PROGRESS SCHEDULE

- A. Comply with Section 01 32 16 - Construction Progress Schedule.
- B. Submit updated schedule with each Application for Payment.

3.04 SUBMITTALS FOR REVIEW

- A. When the following are specified in individual sections, submit them for review:
 1. Product data.
 2. Shop drawings.
 3. Samples for selection.
 4. Samples for verification.
- B. Submit to Engineer for review for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.
- C. Samples
 1. Provide sample or samples identical to the precise article proposed to be provided. Identify as described under "Identification of submittals" below.
 2. Number of samples required:

- a. Unless otherwise specified, submit samples in the quantity which is required to be returned, plus one which will be retained by the Engineer.
 - b. By pre-arrangement in specific cases, a single sample may be submitted for review and, when approved, be installed in the work at a location agreed upon by the Engineer.
- D. Colors and Patterns
- 1. Unless the precise color and pattern is specifically called out in the Contract Documents, and whenever a choice of color or pattern is available in the specified products, submit accurate color and pattern charts to the Engineer for selection and confirmation with the Owner.
- E. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below.

3.05 SUBMITTALS FOR INFORMATION

- A. When the following are specified in individual sections, submit them for information:
- 1. Design data.
 - 2. Certificates.
 - 3. Test reports.
 - 4. Inspection reports.
 - 5. Manufacturer's instructions and literature.
 - 6. Manufacturer's field reports.
 - 7. Other types indicated.
- B. Submit for Engineer's knowledge as contract administrator or for Owner

3.06 SUBMITTALS FOR PROJECT CLOSEOUT

- A. When the following are specified in individual sections, submit them at project closeout:
- 1. Project record documents.
 - 2. Operation and maintenance data.
 - 3. Warranties and Bonds.
 - 4. Keys and Keying Schedule.
 - 5. Spare parts and manuals.
 - 6. Evidence of payment and release of liens per the General Conditions.
 - 7. Section 00 65 19.13 - Contractor's Affidavit.
 - 8. Other types as indicated.

- B. Submit for Owner's benefit during and after project completion.

3.07 NUMBER OF COPIES OF SUBMITTALS

- A. Documents for Review:

- 1. Shop Drawings

- a. Scale and Measurement: Make shop drawings accurately to a scale of sufficiently large to show all pertinent aspects of the item and its method of connection to the Work.
- b. Large Prints (11" X 17" or larger):
 - i. Submit shop drawings in the form of white copies.
 - ii. Blueprints will not be acceptable.
- c. Manufacturer's Literature:
 - i. Where contents of submitted literature from manufacturers includes data not pertinent to the submittal, clearly show which portions of the contents are being submitted for review.
 - ii. Submit the number of copies which are required to be returned, plus three (3) copies which will be retained by the Engineer.
- d. Do not begin fabrication of equipment or materials prior to Engineer's approval of shop drawings.

- B. Documents for Information: Submit three (3).

- C. Documents for Project Closeout: Make one (1) reproduction of submittal originally reviewed. Submit one (1) extra of submittals for information.

- D. Samples: Submit the number specified in individual specification sections; one (1) of which will be retained by Engineer.

- 1. After review, produce duplicates.
- 2. Retained samples will not be returned to Contractor unless specifically so stated.

3.08 SUBMITTAL PROCEDURES

- A. Transmit each submittal with a Cover Letter that stipulates that the items submitted comply or do not comply with the full extent of the specifications. The Cover Letter must also include an explanation of why the items submitted are considered equal to the items specified. Failure to submit a Cover Letter will result in a rejection of the submittal.

- B. Timing of Submittals:

- 1. Within fifteen (15) calendar days after the Contractor has received the Owner's notice to proceed, submit:
 - a. Schedule for submittals including specification section, type of submittal

- and submittal date.
- b. Construction schedule.
- c. Schedule of partial payment requests.
- 2. Make submittals of shop drawings, samples, substitution requests and other items in accordance with the provisions of this Section.
- C. Quality Assurance:
 - 1. Coordination of submittals:
 - a. Prior to each submittal, carefully review and coordinate all aspects of each item being submitted.
 - b. Verify that each item and the submittal for it conform in all respects with the specified requirements.
 - c. By affixing the Contractor's signature to each submittal, certify that this coordination has been performed.
 - 2. The following products do not require further approval except for interface within the Work and where otherwise indicated.
 - a. Products specified by reference to standard specifications such as ASTM, AWWA, and similar standards.
 - b. Products specified by manufacturer's name and catalog model number.
 - 3. Or equal:
 - a. Where the phrase "or equal" occurs in the Contract Documents, do not assume that the materials, equipment or methods will be considered as equal unless the item has been specifically so approved for this Work by the Engineer.
 - b. The decision of the Engineer shall be final.
 - 4. The Engineer shall assume that no shop drawing or related submittal comprises a variation unless the Contractor advises the Engineer otherwise in writing.
- D. Sequentially number submittal in the Cover Letter. Revise submittals with original number and a sequential alphabetic suffix.
- E. Before submitting a shop drawing or any related material, Contractor shall:
 - 1. Review each such submission for conformance with the means, methods, techniques, sequences, and operations of construction, and safety precautions and programs incidental thereto, all of which are the sole responsibility of Contractor.
 - 2. Approve each such submission before submitting it.
 - 3. Stamp each such submission before submitting it.

- F. Shop drawings and related materials shall be returned with comments provided that each submission has been specified and is stamped by the Contractor.
- G. Shop drawings or material not specified or which have not been approved by the Contractor shall be returned without comment.
- H. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work and coordination of information is in accordance with the requirements of the Work and Contract Documents. The following stamp shall be used on all shop drawings: "This Shop Drawing has been reviewed by [Name of Contractor] and approved in accordance with the ways, means, methods, techniques, sequences and procedures associated with the project construction. [Name of Contractor] has approved these Shop Drawings in accordance with safety precautions and programs incidental thereto, and warrants that these Shop Drawings comply with the Contract Documents and includes no variations from the specifications."

Signature
Name and Title (Please Print)
Date

I. Identification of Submittals

- 1. Consecutively number all submittals.
 - a. When material is resubmitted for any reason, transmit under a new letter of transmittal and with a new transmittal number.
 - b. On resubmittals, cite the original submittal number for reference.
- 2. Accompany each submittal with a letter of transmittal showing all information required for identification and checking.
- 3. On at least the first page of each submittal, and elsewhere as required for positive identification, show the submittal number in which the item was included.
- 4. Maintain an accurate submittal log for the duration of the work, showing current status of all submittals at all times. Make the submittal log available to the Engineer for their review upon request.

J. Unrequired submittals will not be reviewed by the Engineer.

K. Submittals required by the Contractor of their subcontractors, such as drawings, setting diagrams or similar information needed to coordinate the construction, shall remain between the Contractor and their subcontractors and these submittals will not be reviewed by the Engineer.

L. Grouping of Submittals

- 1. Unless otherwise specified, make submittals in groups containing all associated items to assure that information is available for checking each item when it is received.
 - a. Partial submittals may be rejected as not complying with the provisions of the Contract.
 - b. The Contractor may be held liable for delays so occasioned.

M. Timing of Submittals

1. Make submittals far enough in advance of scheduled dates for installation to provide time required for reviews, for securing necessary approvals, for possible revisions and resubmittals, and for placing orders and securing delivery.

N. Resubmittal Schedule

1. For submittals marked "Furnish as Corrected" by the Engineer, resubmittal shall be within fifteen (15) days of the review date shown on the Engineer's shop drawing review stamp.
2. For submittals marked "Revise and Resubmit", "Submit Specified Item", or "Rejected", resubmittal shall be within fifteen (15) days of the review date shown on the Engineer's shop drawing review stamp.

O. Engineer's Review

1. Review by the Engineer does not relieve the Contractor from responsibility for errors which may exist in the submitted data.
2. Revisions:
 - a. Make revisions required by the Engineer.
 - i. If the Contractor considers any required revision to be a change, they shall so notify the Engineer as provided for in the General Conditions.
 - ii. Make only those revisions directed or approved by the Engineer.
 - iii. Submittals which have been reviewed and returned to the Contractor marked "Revise and Resubmit" or "Rejected" and which are resubmitted and not in an approved state, will not be reviewed a third time unless payment for the third and any subsequent review is by the Contractor. The engineering costs for review shall be equal to the Engineer's charges to the Owner under the terms of the Engineering Agreement with the Owner.

P. Deliver submittals to Engineer at business address.

Q. Schedule submittals to expedite the Project, and coordinate submission of related items.

R. For each submittal for review, allow twenty-five (25) working days excluding delivery time to and from the Contractor.

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

T. Provide space for Contractor and Engineer review stamps.

U. When revised for resubmission, identify all changes made since previous submission.

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

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

END OF SECTION

SECTION 01 31 00

CONSTRUCTION SCHEDULES

PART 1 GENERAL

1.01 DESCRIPTION

- A. Work included: Construction Schedules are to be prepared to provide assurance of project planning and the execution of the work so that the construction is completed within the construction period as stated in the Contract Documents, and to provide Alliance Consulting Engineers, Inc. a means to evaluate the progress of the work.
- B. Related work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, and Sections in Division 01 of these Specifications.
 - 2. General Conditions and the requirements associated with the progress schedule.
 - 3. Construction period: As related to the executed contract.
- C. Definitions: "Day", means calendar day.

1.02 QUALITY ASSURANCE

- A. The Contractor is to provide a scheduler that is thoroughly trained and experienced in preparing construction schedule data, and in preparing and issuing periodic schedule reports as stated below.
- B. Perform data preparation that includes analysis, charting and updating as required.
- C. Reliance upon the approved schedule:
 - 1. Once approved by Alliance Consulting Engineers, Inc., the construction schedule will be an integral part of the Contract and will establish interim completion dates for the various construction tasks specified in the Contract.
 - 2. The Contractor agrees and understands that the failure of the Owner to exercise this option either to order the Contractor to expedite an activity or to expedite the activity by other means shall not be considered a precedent for any other scheduled activities.

1.03 SUBMITTALS

- A. Comply with provisions of Section 01 30 00 Administrative Requirements.
- B. Once the preliminary schedule has been reviewed and approved by Alliance Consulting Engineers, Inc., within ten (10) calendar days, the Contractor must submit one (1) reproducible copy and four (4) prints of a preliminary construction schedule prepared in accordance with Part 3 of this Section.
- C. Once the Contractor receives final review and approval of the preliminary construction schedule, the Contractor must submit within ten (10) calendar days one (1) reproducible copy and four (4) prints of a construction schedule prepared in accordance with Part 3 of

this Section.

- D. The Contractor must also provide on the first working day of each month, four (4) prints of the construction schedule that has been updated in accordance with Part 3 of this Section.

PART 2 PRODUCTS

2.01 CONSTRUCTION ANALYSIS

- A. The construction schedule must illustrate graphically by bar chart the order and interdependence of all construction activities required to complete the work, and the sequence in which the construction activities are to be completed. All construction activities must be planned by the Contractor and their project field superintendent in coordination with all subcontractors whose work is shown on the diagram and any other work being completed on the project site by other contractors that requires coordination.
 - 1. The graphical chart must be a two (2) line bar chart; with one (1) bar for planned activities, and one (1) bar for actual activity completion.
- B. Include, but do not necessarily limit indicated activities to:
 - 1. Project mobilization.
 - 2. Submittal and approval of shop drawings and sample data.
 - 3. Procurement of equipment and critical materials.
 - 4. Fabrication of special material and equipment, and its installation and testing.
 - 5. Each construction activity that is critical to the work being performed.
 - 6. All activities by Alliance Consulting Engineers, Inc. that affect progress, required dates for completion, or both, for all and each part of the Work.
 - 7. All activities by other contractors that have to be coordinated with the work being completed under this Contract.
 - 8. Final cleanup.
 - 9. Final inspecting and testing.

PART 3 EXECUTION

3.01 PRELIMINARY ANALYSIS

- A. Contents:
 - 1. Outline the activities of the Contractor for the period between receipt of Notice to Proceed and submittal of construction schedule.
 - 2. Outline the Contractor's approach to the remaining work to be completed.
 - 3. Outline the costs of all activities scheduled before submittal and approval of the construction schedule.

3.02 CONSTRUCTION SCHEDULE

- A. Provide a construction schedule that incorporates all of the revisions from review of the preliminary analysis.

3.03 PERIODIC REPORTS

- A. Provide monthly updates of the approved construction schedule.
 - 1. Indicate "actual" progress for each activity on the bar chart.
 - 2. Provide written narrative summary of revisions causing delay in the construction, and an explanation of corrective actions being taken or proposed.

3.04 REVISIONS

- A. Provide a revised construction schedule periodically that includes delays, early completion, etc.
- B. Any revisions to the construction schedule must be approved by Alliance Consulting Engineers, Inc. before acceptance.

END OF SECTION

SECTION 01 32 00

PROJECT CONSTRUCTION SEQUENCE AND PROVISIONS

PART 1 GENERAL

1.01 CONSTRUCTION AREAS

- A. The Contractor shall limit their use of the construction areas for work and for storage to allow for:
 - 1. Work by other Contractors.
 - 2. Owner use.
 - 3. Public use.
- B. Coordinate use of work site under direction of Engineer.
- C. Assume full responsibility for the protection and safekeeping of materials and products under this Contract, stored on the site.
- D. Move any stored products, under Contractor's control, which interfere with operations of the Owner or separate Contractor.
- E. Obtain and pay for the use of additional storage of work areas needed for operations.

1.02 SPECIFICATIONS

- A. Specifications

The Technical Specifications consist of three parts: General, Products and Execution. The General Section contains General Requirements which govern the work. Products and Execution modify and supplement these by detailed requirements of the work and shall always govern whenever there appears to be a conflict.

- B. Intent

All work called for in the Specifications applicable to this Contract, but not shown on the plans in their present form, or vice versa, shall be of like effect as if shown or mentioned in both. Work not specified in either the plans or the Specifications, but involved in carrying out their intent or in the complete and proper execution of the work is required and shall be performed by the Contractor as though it were specifically delineated or described.

The apparent silence of the specifications as to any detail, or the apparent omission from them of a detailed description concerning any work to be done and materials to be furnished, shall be regarded as meaning that only the best general practice is to prevail and that only material and workmanship of the best quality is to be used, and interpretation of these specifications shall be made upon that basis. The inclusion of the General Requirements (or work specified elsewhere) in the General part of the specifications is only for the convenience of the Contractor, and shall not be interpreted as a complete list of related Specification Sections.

1.03 WORK IN PROGRESS

The Contractor shall furnish personnel and equipment which will be efficient, appropriate, and adequately sized to secure a satisfactory quality of work and a rate of progress which will insure the

completion of the work within the time stipulated in the Proposal. If at any time such personnel appears to the Engineer to be inefficient, inappropriate, or insufficient for securing the quality of work required for producing the rate of progress aforesaid, they may order the Contractor to increase the efficiency, change the character, or increase the personnel and equipment, and the Contractor shall conform to such order. Failure of the Engineer to give such order shall in no way relieve the Contractor of their obligations to secure the quality of the work and rate of progress required.

1.04 UTILITY SYSTEMS AND FACILITIES

- A. The Contractor shall interrupt water, telephone, power, cable TV, sewer, gas or other related utility services and disturb the normal functioning of the system as little as possible. They shall notify the Engineer and the appropriate agency well in advance of any requirements for dewatering, isolating, or relocating a section of a utility, so that necessary arrangements may be made with the appropriate agency.
- B. The Contractor shall assume full responsibility for the protection of all buildings, structures, and utilities, public or private, including poles, signs, services to buildings, utilities in the street, gas pipes, water pipes, hydrants, sewers, storm drains and electric and telephone cables, whether or not they are shown on the Drawings. The Contractor shall carefully support and protect all such structures and utilities from injury of any kind. Any damage resulting from the Contractor's operations shall be repaired by the Contractor at their expense.
- C. The Contractor shall bear full responsibility for obtaining locations of all underground structures and utilities (including existing water services, gas lines, fiber optic, drain lines, and sewers). Services to buildings shall be maintained, and all costs or charges resulting from damage thereto shall be paid by the Contractor.
- D. Protection and temporary removal and replacement of existing utilities and structures as described in this Section shall be a part of the work under the Contract and no separate payment will be made for this work.
- E. If, in the opinion of the Engineer, permanent relocation of a utility owned by the Owner is required, they may direct the Contractor in writing, to perform the work. Work so ordered will be paid for at the contract unit prices, if applicable, or as extra work. If relocation of a privately owned utility is required, the Owner will notify the utility to perform the work as expeditiously as possible. The Contractor shall fully cooperate with the Owner and utility and shall have no claim for delay due to such relocation. The Contractor shall notify all utility companies in writing at least 48 hours (excluding Saturdays, Sundays, and legal holidays) before excavating near their utilities.
- F. The Contractor shall be responsible to maintain water, telephone, power, cable TV, sewer, gas and other related utilities throughout construction at no additional cost to the Owner.
- G. The Contractor shall fully cooperate with all private and public utilities during the installation of new facilities, or relocation of existing facilities. The Contractor shall coordinate their work accordingly and shall have no claim except for time extension for delays associated with the proposed utility improvements.

1.05 TEST PITS

- A. Test pits for the purpose of locating underground pipeline or structures in advance of the construction shall be excavated and backfilled by the Contractor at the direction of the Engineer. Test pits shall be backfilled immediately after their purpose has been satisfied and the surface restored and maintained in a manner satisfactory to the Engineer. No separate payment will be made.

1.06 CARE AND PROTECTION OF PROPERTY

- A. The Contractor shall be responsible for the preservation of all public and private property, and shall use every precaution necessary to prevent damage thereto. If any direct or indirect damage is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work on the part of the Contractor, such property shall be restored by the Contractor, at their expense, to a condition similar or equal to that existing before the damage was done, or they shall make good the damage in another manner acceptable to the Engineer.
- B. All sidewalks and driveways which are disturbed by the Contractor's operations shall be restored to their original or better condition by the use of similar or comparable materials.
- C. Along the location of this work all fences, walks, bushes, trees, shrubbery, and other physical features shall be protected and restored in a thoroughly workmanlike manner. Fences and other features removed by the Contractor shall be replaced in the location indicated by the Engineer as soon as conditions permit. All grass areas beyond the limits of construction which have been damaged by the Contractor shall be regraded and seeded.
- D. Trees close to the work shall be boxed or otherwise protected against injury. The Contractor shall trim all branches that are liable to damage because of their operations, but in no case shall any tree be cut or removed without prior notification of the tree warden. All injuries to bark, trunk, limbs, and roots of trees shall be repaired by dressing, cutting, and painting according to approved methods, using only approved tools and materials.
- E. The protection, removal, and replacement of existing physical features along the line of work shall be a part of the work under the Contract, and all costs in connection therewith shall be included in the unit and/or lump sum prices established under other items in the Proposal.

1.07 CLEAN-UP

- A. During the course of the work, the Contractor shall keep the site of their operations in as clean and neat of a condition as is possible. They shall dispose of all residue resulting from the construction work and, at the conclusion of the work, they shall remove and haul away any surplus excavation, broken pavement, brick, lumber, equipment, temporary structures, and any other refuse remaining from the construction operations, and shall leave the entire site of the work in a neat and orderly condition.
- B. In order to prevent environmental pollution arising from the construction activities related to the performance of this Contract, the Contractor and their subcontractors shall comply with all applicable Federal, State and local laws and regulations concerning waste material disposal, as well as the specific requirements stated in this Section and elsewhere in the Specifications.
- C. The Contractor is advised that the disposal of excess excavated material in wetlands, stream corridors and plains is strictly prohibited even if the permission of the property owner is obtained. Any violation of this restriction by the Contractor or any person employed by them, will be brought to the immediate attention of the responsible regulatory agencies, with a request that appropriate action be taken against the offending parties. The Contractor will be responsible to pay all fines, remove the fill, and restore the area impacted.

1.08 PROTECTION OF CONSTRUCTION AND EQUIPMENT

- A. All newly constructed work shall be carefully protected from injury in any way. No wheeling or walking or placing of heavy loads on it shall be allowed and all portions injured shall be reconstructed by the Contractor at their own expense.

- B. All structures shall be protected in a manner approved by the Engineer. Should any of the structures become heaved, cracked, or otherwise damaged, all such damaged portions of the work shall be completely repaired and made good by the Contractor, at their own expense, and to the satisfaction of the Engineer. If, in the final inspection of the work, any defects, faults, or omissions are found, the Contractor shall cause the same to be repaired or removed and replaced by proper materials and workmanship without extra compensation for the materials and labor required. Further, the Contractor shall be fully responsible for the satisfactory maintenance and repair of the construction and other work undertaken herein, for at least the guarantee period described in the Contract.
- C. Further, the Contractor shall take all necessary precautions to prevent damage to any structure due to water pressure during and after construction and until such structure is accepted and taken over by the Owner.

1.09 PROJECT SEQUENCING

- A. Construct work in stages to accommodate operation of existing facilities during construction period. Coordinate construction schedule and operations with the Owner and the Engineer. Owner reserves the right to place facilities, taken out of service by Contractor, back into service on emergency basis upon notification to Contractor.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

SECTION 01 40 00

QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. References and standards.
- B. Quality assurance submittals
- C. Control of installation.
- D. Inspection services.
- E. Cooperate with the Owner's selected testing agency and all others responsible for testing and inspecting the work.
- F. Provide such other testing and inspecting as are specified to be furnished by the Contractor in this Section and/or elsewhere in the Contract Documents.

1.02 RELATED REQUIREMENTS

- A. Document 00 72 13 – Standard General Conditions of the Construction Contract: Inspections and approvals required by public authorities.
- B. Section 01 30 00 - Administrative Requirements: Submittal procedures.
- C. Section 01 60 00 - Product Requirements: Requirements for material and product quality.
- D. Requirements for testing may be described in various Sections of these specifications.
- E. Where no testing requirements are described, but the Owner decides that testing is required, the Owner may require such testing to be performed under current pertinent standards for testing. Payment for such testing will be made as described in this Section.

1.03 ADDITIONAL WORK INCLUDED:

- A. Selection of testing laboratory: The contractor shall provide all necessary testing by a prequalified independent testing laboratory. This information shall be provided to the Engineer for approval during the shop drawing review process.
- B. Payment for initial testing: The selected contractor's contract shall provide all necessary services of the testing laboratory within the contract prices to the owner as further described in Article 2.1 of this Section.
- C. Tests at point of manufacture as specified in other Sections of these documents are to be made with all costs borne by the Contractor.

1.04 REFERENCE STANDARDS

- A. ASTM C 1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation; 2009.

- B. ASTM D 3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2008.
- C. ASTM E 329 - Standard Specification for Agencies Engaged Construction Inspection and/or Testing; 2009.

1.05 SUBMITTALS

- A. Testing Agency Qualifications:
 - 1. Prior to start of Work, submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
- B. Test Reports: After each test/inspection, promptly submit three (3) copies of report to Alliance Consulting Engineers, Inc. and to Owner.
 - 1. Include:
 - a. Date issued.
 - b. Project title and number
 - c. Name of inspector
 - d. Date and time of sampling or inspection
 - e. Identification of product and specifications section
 - f. Location in the Project
 - g. Type of test/inspection
 - h. Date of test/inspection
 - i. Results of test/inspection
 - j. Conformance with Contract Documents
 - k. When requested by Alliance Consulting Engineers, Inc., provide interpretation of results.
 - 2. Test report submittals are for Alliance Consulting Engineers Inc.'s knowledge as contract administrator for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents, or for Owner information
- C. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Alliance Consulting Engineers, Inc., in quantities specified for Product Data.
 - 1. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
 - 2. Certificates may be recent or previous test results on material or product, but

must be acceptable to Alliance Consulting Engineers, Inc.

- D. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

1.06 REFERENCES AND STANDARDS

- A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.
- C. Obtain copies of standards where required by product specification sections.
- D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.
- E. Should specified reference standards conflict with Contract Documents, request clarification from Alliance Consulting Engineers, Inc. before proceeding.
- F. Neither the contractual relationships, duties, nor responsibilities of the parties in Contract nor those of Alliance Consulting Engineers, Inc. shall be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.07 QUALITY ASSURANCE

- A. The testing laboratory will be qualified to the Owner's approval in accordance with ASTM E 329.
- B. Testing, when required, will be in accordance with all pertinent codes and regulations, and with selected standards of the American Society for Testing and Materials.

1.08 PRODUCT HANDLING

- A. Comply with pertinent provisions of Section 01 60 00 Product Requirements.
- B. Promptly process and distribute required copies of test reports and related instructions to assure necessary retesting and replacement of materials with the least possible delay in progress of the work.

PART 2 PRODUCTS

2.01 PAYMENT FOR TESTING

- A. Testing Services:
 - 1. The Owner will pay for all testing services required by the contract documents and manufacturer's recommendations.
 - 2. When initial tests indicate non-compliance with the Contract Documents, any all

retesting and consulting required to provide compliance with the Contract Documents will be the responsibility of the contractor at no additional costs to the Owner.

3. Retesting: When initial tests indicate non-compliance with the Contract Documents, subsequent re-testing occasioned by the non-compliance shall be performed by the same testing agency.

2.02 CODE COMPLIANCE TESTING

- A. Inspections and tests required by codes or ordinances, or by a plan approval authority, and which are made by a legally constituted authority, shall be the responsibility of and shall be paid for by the Contractor, unless otherwise provided in the Contract Documents.

2.03 CONTRACTOR'S CONVENIENCE TESTING

- A. Inspecting and testing performed exclusively for the Contractor's convenience shall be the sole responsibility of the Contractor.

PART 3 EXECUTION

3.01 CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Alliance Consulting Engineers, Inc. before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have Work performed by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 CONTRACTOR TESTING COORDINATION:

- A. Cooperation with Testing Laboratory:
 1. Representatives of the testing laboratory shall have access to the work at all times and at all locations where the work is in progress. Provide facilities for such access to enable the laboratory to perform its functions properly.
- B. Taking Specimens:
 1. All specimens and samples for testing, and deliveries to laboratory, unless

otherwise provided in the Contract Documents, shall be taken by the testing personnel. All sampling equipment and personnel will be provided by the testing laboratory. All deliveries of specimens and samples to the testing laboratory will be performed by the testing laboratory.

3.03 SCHEDULES FOR TESTING

- A. Establishing schedule:
 - 1. By advance discussion with the testing laboratory approved by the Owner, determine the time required for the laboratory to perform its tests and to issue each of its findings.
 - 2. Provide all required time within the construction schedule.
- B. Revising schedule: When changes of construction schedule are necessary during construction, coordinate all such changes with the testing laboratory as required.
- C. Adherence to schedule: When the testing laboratory is ready to test according to the established schedule, but is prevented from testing or taking specimens due to incompleteness of the work, all extra charges for testing attributable to the delay may be back-charged to the Contractor and shall not be borne by the Owner.

3.04 TESTING AND INSPECTION

- A. Testing Agency Duties:
 - 1. Provide qualified personnel at site. Cooperate with Alliance Consulting Engineers, Inc. and Contractor in performance of services.
 - 2. Perform specified sampling and testing of products in accordance with specified standards.
 - 3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 - 4. Promptly notify Alliance Consulting Engineers, Inc. and Contractor of observed irregularities or non-conformance of Work or products.
 - 5. Perform additional tests and inspections required by Alliance Consulting Engineers, Inc.
 - 6. Submit reports of all tests/inspections specified.
- B. Limits on Testing/Inspection Agency Authority:
 - 1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 - 2. Agency may not approve or accept any portion of the Work.
 - 3. Agency may not assume any duties of Contractor.
 - 4. Agency has no authority to stop the Work.

- C. Contractor Responsibilities:
 - 1. Provide incidental labor and facilities:
 - a. To provide access to Work to be tested/inspected
 - b. To facilitate tests/inspections
 - 2. Notify Alliance Consulting Engineers, Inc. and laboratory twenty-four (24) hours prior to expected time for operations requiring testing/inspection services.
 - 3. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
 - 4. Arrange with the Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
- D. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Alliance Consulting Engineers, Inc.
- E. Re-testing required because of non-conformance to specified requirements shall be paid for by Contractor.
- F. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Alliance Consulting Engineers, Inc. Payment for re testing will be charged to the Contractor by deducting testing charges from the Contract Price.

3.05 DEFECT ASSESSMENT

- A. Replace Work or portions of the Work not conforming to specified requirements.
- B. If, in the opinion of Alliance Consulting Engineers, Inc., it is not practical to remove and replace the Work, Alliance Consulting Engineers, Inc. will direct an appropriate remedy or adjust payment.

END OF SECTION

SECTION 01 41 26

PERMITS AND RIGHTS-OF-WAY

PART 1 GENERAL

1.01 DESCRIPTION

- A. Work included: This section outlines the requirements of the Contractor for the payment for any fees and the acquisition of any required licenses, building permits, rights-of-ways, easements, etc., that may be required for the construction of the project.
- B. Work not included: The Owner will obtain and provide to the Contractor, copies of the following, if required:
 - 1. South Carolina Water Resources permits.
 - 2. South Carolina Department of Health and Environmental Control, Permit to Construct.
 - 3. South Carolina Department of Transportation (SCDOT) Encroachment Permit
- C. Related work: Documents affecting work of this section include, but are not necessarily limited to, General Conditions and Sections in Division 01 of these specifications.

1.02 SUBMITTALS

- A. Submit to the Engineer and post at the site, satisfactory evidence that all required licenses, building permits, etc., have been obtained prior to start of construction.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 BUSINESS LICENSE

- A. Verify licenses that are required to perform the work within the project area, and obtain at no additional cost to the Owner.

3.02 RIGHTS-OF-WAY, UTILITY LINES

- A. The Contractor shall confine their activities to the project limits as illustrated in the Contract Documents.
- B. The Owner will provide no right-of-way over other property.

3.03 LAND

- A. The necessary land for construction of the proposed improvements will be provided by the Owner.

END OF SECTION

SECTION 01 42 19

REFERENCE STANDARDS

PART 1 GENERAL

1.01 DESCRIPTION

- A. Throughout these Contract Documents, references are made to specifications and standards that have been issued by nationally recognized professional and/or trade organizations. These referenced standards are generally identified by abbreviating the name of the organization following with the specification/standard number, and unless specifically indicated otherwise, all references to standards refer to the latest edition available at the time of the bidding.

1.02 ABBREVIATIONS

- A. Wherever the following abbreviations are used in these Contract Documents, these abbreviations are to be considered as the same as the respective expressions represented below:

1.	AASHO	American Association of State Highway Officials
2.	ACI	American Concrete Institute
3.	AISC	American Institute of Steel Construction
4.	ALS	American Lumber Standards
5.	ANSI	American National Standards Institute, Inc.
6.	ASTM	American Society for Testing and Materials
7.	AWWA	American Water Works Association
8.	AWPA	American Wood Preservers Association
9.	AWS	American Welding Society
10.	FSS	Federal Specifications and Standards, General Services Administration
11.	SPIB	Southern Pine Inspection Bureau
12.	SSPC	Steel Structures Painting Council

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 45 29

TESTING LABORATORY SERVICES

PART 1 GENERAL

1.01 SCOPE

- A. This Section includes testing which the Owner may require, beyond that testing required of the manufacturer, to determine if materials provided for the Project meet the requirements of these Specifications.
- B. This work also includes all testing required by the Owner to verify work performed by the Contractor is in accordance with the requirements of these Specifications, i.e., concrete strength and slump testing, soil compaction, etc.
- C. This work does not include materials testing required in various sections of these Specifications to be performed by the manufacturer, e.g., testing of pipe.

1.02 SECTION INCLUDES

- A. Selection of Testing Laboratory.
- B. Laboratory Duties.
- C. Payment for Testing Services.
- D. Contractor Responsibilities.
- E. Schedules for Testing.
- F. Transporting Samples.

1.03 SELECTION OF TESTING LABORATORY

The testing laboratory or laboratories will be selected by the Contractor, subject to the approval of the Owner.

1.04 LABORATORY DUTIES

- A. Cooperate with the Owner, Engineer and Contractor.
- B. Provide qualified personnel promptly on notice.
- C. Perform specified inspections, sampling and testing of materials.
 - 1. Comply with specified standards, ASTM, other recognized authorities, and as specified.
 - 2. Ascertain compliance with requirements of the Contract Documents.
- D. Promptly notify the Engineer and Contractor of irregularity or deficiency of work which are observed during performance of services.
- E. Promptly submit three copies (two copies to the Engineer and one copy to the Contractor) of report of inspections and tests in addition to those additional copies required by the Contractor with the following information included:

1. Date issued
 2. Project title and number
 3. Testing laboratory name and address
 4. Name and signature of inspector
 5. Date of inspection or sampling
 6. Record of temperature and weather
 7. Date of test
 8. Identification of product and Specification section
 9. Location of Project
 10. Type of inspection or test
 11. Results of test
 12. Observations regarding compliance with the Contract Documents
- F. Perform additional services as required.
- G. The laboratory is not authorized to release, revoke, alter or enlarge on requirements of the Contract Documents, or approve or accept any portion of the Work.

1.05 PAYMENT FOR TESTING SERVICES

- A. The cost of testing services required by the Contract shall be paid for by the Owner and shall be included in the cost of the work to which it pertains.
- B. The cost of additional testing services not specifically required in the Specifications, but requested by the Owner or Engineer, shall be paid for by the Owner.
- C. The cost of material testing described in various sections of these Specifications or as required in referenced standards to be provided by a material manufacturer, shall be included in the price bid for that item and shall not be paid for by the Owner.
- D. The cost of retesting any item that fails to meet the requirements of these Specifications shall be paid for by the Contractor.

1.06 CONTRACTOR RESPONSIBILITIES

- A. Contractor will be furnished contact information for the selected laboratory. Contractor will be required to schedule ALL testing.
- B. Cooperate with laboratory personnel, provide access to Work and/or manufacturer's requirements.
- C. Provide to the laboratory, representative samples, in required quantities, of materials to be tested.
- D. Furnish copies of mill test reports.
- E. Furnish required labor and facilities to:

1. Provide access to Work to be tested;
 2. Obtain and handle samples at the site (if certified to do so);
 3. Facilitate inspections and tests;
 4. Build or furnish a holding box for concrete cylinders or other samples as required by the laboratory.
- F. Notify the laboratory sufficiently in advance of operation to allow for the assignment of personnel and schedules of tests.
- G. Laboratory Tests: Where such inspection and testing are to be conducted by an independent laboratory agency, the sample(s) shall be selected by such laboratory or agency, or the Engineer, and shipped to the laboratory by the Contractor at Contractor's expense.
- H. Copies of all correspondence between the Contractor and testing agencies shall be provided to the Engineer.
- I. If the Contractor disagrees with the approved Engineer's testing agency's methods or results during an onsite test, the Contractor may have another testing agency conduct an independent evaluation at the Contractor's expense. After an independent evaluation is performed, the Contractor will submit their results to the Engineer for review.

1.07 SCHEDULES FOR TESTING

- A. Establishing Schedule
1. The Contractor shall, by advance discussion with the testing laboratory, determine the time required for the laboratory to perform its tests and to issue each of its findings, and make all arrangements for the testing laboratory to be on site to provide the required testing.
 2. Provide all required time within the construction schedule.
- B. When changes of construction schedule are necessary during construction, coordinate all such changes of schedule with the testing laboratory as required.
- C. When the testing laboratory is ready to test according to the determined schedule, but is prevented from testing or taking specimens due to incompleteness of the Work, all extra costs for testing attributable to the delay will be back-charged to the Contractor and shall not be borne by the Owner.

1.08 TRANSPORTING SAMPLES

The Contractor shall be responsible for transporting all samples, except those taken by testing laboratory personnel, to the testing laboratory.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 55 10

VEHICULAR ACCESS AND PARKING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Access roads.
- B. Parking.
- C. Maintenance

PART 2 PRODUCTS

2.01 MATERIALS

- A. Temporary Construction: Per Detail on Plans

PART 3 EXECUTION

3.01 PREPARATION

- A. Clear areas, provide surface and storm drainage of road, parking, area premises, and adjacent areas

3.02 ACCESS ROADS

- A. All material shall be delivered to the site by use of the existing driveways and the publicly-owned stated highways that connect to the site.

3.03 PARKING

- A. Locate as approved by Engineer

3.04 MAINTENANCE

- A. Maintain traffic and parking areas in a sound condition free of excavated material, construction equipment, products, mud, snow, and ice.
- B. Maintain existing paved areas used for construction. Promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original, or specified, condition.

3.05 REMOVAL, REPAIR

- A. Remove equipment and devices when no longer required.
- B. Repair damage caused by installation.

3.06 MUD FROM SITE VEHICLES

- A. Provide means of removing mud from vehicle wheels before entering streets.

END OF SECTION

SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General product requirements.
- B. Re-use of existing products.
- C. Transportation, handling, storage and protection.
- D. Product option requirements.
- E. Substitution limitations and procedures.
- F. Maintenance materials, including extra materials, spare parts, tools, and software.
- G. Protect products scheduled for use in the work by means including, but not necessarily limited to, those described in this Section.

1.02 RELATED REQUIREMENTS

- A. Document 00 21 13 - Instructions to Bidders: Product options and substitution procedures prior to bid date.
- B. Section 01 40 00 - Quality Requirements: Product quality monitoring.
- C. Documents affecting work of this Section include, but are not necessarily limited to, Standard General Conditions of the Construction Contract and Sections in Division 01 of these specifications.
- D. Additional procedures also may be prescribed in other Sections of these specifications.

1.03 SUBMITTALS

- A. Proposed Products List: Submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
 - 1. Submit within fifteen (15) days after date of Agreement.
 - 2. For products specified only by reference standards, list applicable reference standards.
- B. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- C. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

- D. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
 - 1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.
- E. Indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

1.04 QUALITY ASSURANCE

- A. Include within the Contractor's quality assurance program such procedures as are required to assure full protection of work and materials.

1.05 MANUFACTURER'S RECOMMENDATIONS

- A. Except as otherwise approved by the Engineer, determine and comply with manufacturer's recommendations on product handling, storage and protection.

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS

- A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by the Contract Documents.
- B. Unforeseen historic items encountered remain the property of the Owner; notify the Owner promptly upon discovery; protect, remove, handle, and store as directed by the Owner.
- C. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Owner, or otherwise indicated as to remain the property of the Owner, become the property of the Contractor; remove from site.
- D. Reused Products: Reused products include materials and equipment previously used in this or other construction, salvaged and refurbished as specified.

2.02 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by the Contract Documents.

2.03 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.04 MAINTENANCE MATERIALS

- A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.

- B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION PROCEDURES

- A. Instructions to Bidders specify time restrictions for submitting requests for substitutions during the bidding period. Comply with requirements specified in this section.
- B. Alliance Consulting Engineers, Inc. will consider requests for substitutions only within fifteen (15) days after date of Agreement.
- C. Document each request with complete data substantiating compliance of proposed substitution with Contract Document
- D. A request for substitution constitutes a representation that the submitter:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
 - 2. Will provide the same warranty for the substitution as for the specified product.
 - 3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension that may subsequently become apparent.
 - 5. Will reimburse the Owner and Alliance Consulting Engineers, Inc. for review or redesign services associated with re-approval by authorities.
- E. Substitution Submittal Procedure:
 - 1. Submit three (3) copies of request for substitution for consideration. Limit each request to one proposed substitution.
 - 2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
 - 3. Alliance Consulting Engineers, Inc. will notify Contractor in writing of decision to accept or reject request.

3.02 PACKAGING

- A. Deliver products to the job site in their manufacturer's original container, with labels intact and legible.
 - 1. Maintain packaged materials with seals unbroken and labels intact until time of use.
 - 2. Promptly remove damaged material and unsuitable items from the job site and promptly replace with material meeting the specified requirements, at no additional cost to the Owner.

- B. The Engineer may reject as non-complying such material and products that do not bear identification satisfactory to the Engineer as to manufacturer, grade, quality and other pertinent information.

3.03 TRANSPORTATION AND HANDLING

- A. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- B. Transport and handle products in accordance with manufacturer's instructions.
- C. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- D. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- E. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.
- F. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.04 STORAGE AND PROTECTION

- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels intact and legible.
- D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- G. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- H. Prevent contact with material that may cause corrosion, discoloration, or staining.
- I. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- J. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.
- K. Partial payments under the Contract will not relieve the Contractor from responsibility.
 - 1. When materials and work at the site that have been partially paid for are not adequately protected by the Contractor, such materials will be protected by the

Owner at the expense of the Contractor and no further partial payment thereon will be made.

- L. Maintain finished surfaces clean, unmarred, and suitably protected until accepted by the Owner.
- M. Electrical and control equipment:
 - 1. Store in a dry area protected from dust and humidity.
 - 2. Equipment can be protected by a weatherproof cover if shipped to the site no more than two (2) weeks prior to installation and energization.

3.05 REPAIRS AND REPLACEMENTS

- A. In the event of damage, promptly make replacements and repairs to the approval of the Engineer and at no additional cost to the Owner.
- B. Additional time required to secure replacements and to make repairs will not be considered by the Engineer to justify an extension in the contract time of completion.

END OF SECTION

SECTION 01 61 00

GENERAL EQUIPMENT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements relating to providing of equipment and services specified in other Sections of these specifications.

1.02 RELATED SECTIONS

- A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions and Sections of Division 01 of these Specifications.
- B. Additional provisions concerning this work may be stated in other sections associated with these specifications.
- C. Where new equipment is to be installed into existing structures or systems, verify the plan dimensions with existing dimensions and provide all discrepancies as part of the shop drawings.
- D. Equipment provided as part of this Section shall be installed in the location provided and within the space as indicated on the Construction Plans.
- E. Any structural, piping, wiring, drawings, or other modifications required to accommodate equipment offered other than that shown on the Drawings, or specified, shall be provided at no additional cost to the Owner.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Certificates: Certify that products of this section meet or exceed specified requirements.
- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in the Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

- A. Equipment manufacturers shall, upon request of the Engineer, provide a detailed list of installations of comparable function.
- B. Equipment in each Section shall be by a single manufacturer regularly engaged in the development of equipment designed for the intended function.
- C. Provide each component with a serial number and the manufacturer shall maintain records of same.
- D. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, will provide a list that includes years of experience, projects similar in type, size, and cost, as well as a list of references for each similar project.

- E. Perform design, if required, of Tank, Structural, Foundation, and Electrical under direct supervision of a Professional Engineer experienced in design of this Work and licensed in South Carolina.
- F. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.

1.05 PRE-INSTALLATION MEETING

- A. Convene one week before starting work of this section.

1.06 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a one (1) year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL

- A. Supply all materials, tools, equipment, labor and supervision to properly complete installation of equipment, piping, controls, etc., in compliance with the contract documents.

2.02 IDENTIFICATION

- A. Provide stamped identification labels on motors and equipment with pertinent information including serial numbers, model numbers, capacities, voltage, amps, etc.
- B. Label to be aluminum or stainless steel.
- C. Attach with stainless steel or aluminum hardware.

2.03 LUBRICANTS AND LUBRICATING EQUIPMENT

- A. Provide and install all necessary oils, greases, etc., for initial operation of equipment.
- B. Where manufacturer's recommendations include changing of initial lubricants after 1,000-hours or less of operation, provide sufficient lubricants to make the change.
- C. Provide one of every type lubricating gun required to properly maintain the equipment.

2.04 OPERATION, MAINTENANCE AND SERVICE MANUALS

- A. Prepare and submit for the Owner's use six (6) copies of O&M Manual for each piece of equipment.
 - 1. Submit Manuals sixty (60) days prior to delivery of equipment.
- B. Manuals shall be specific to the equipment supplied.
 - 1. Manuals applicable to many different configurations and which require the operator to selectively read portions of the instructions will not be accepted.
 - 2. The equipment model that the Manual applies to shall be indicated by an arrow.

- C. Provide a Table of Contents specific to each Manual.
- D. At the beginning of each Manual, provide a description of the equipment to include model numbers, purchase order numbers, serial numbers, motor information and performance and design criteria.
- E. Correlate Manuals with the approved shop drawings and include the following minimum information:
 - 1. Parts list, including recommended spare parts list.
 - 2. Recommended maintenance instructions.
 - 3. Recommended lubricants and lubrication instructions.
 - 4. Address and telephone number of the source for repairs, spare parts and service.
 - 5. Detailed description of operating procedure for the item of equipment specifically written for this installation, including start-up and shutdown procedures.
 - 6. Equipment performance specifications, including pump curves.
 - 7. Results of start-up and any further recommendations resulting from start-up.
 - 8. Current cost for each recommended spare part and agreement to provide updated costs at Owner's request.
- F. Provide a maintenance and lubrication schedule to be a summary of all preventative maintenance and lubrication, including the following information:
 - 1. Title.
 - 2. Type of activity (inspection, adjustment, oil change, etc.).
 - 3. Brief description of activity.
 - 4. Type of lubricant.
 - 5. Frequency (daily, weekly, etc.).
- G. The manufacturer shall provide the Owner with a log chart to record all servicing and maintenance required during the equipment warranty period.
- H. For process oriented equipment, treatment plants, etc., provide a detailed description of the process operation and trouble-shooting of problems.
- I. Provide clear and legible copies. Type parts lists, etc.
- J. Layout and detail drawings shall be reduced to a maximum size of 11" x 17", unless written approval is received from the Engineer prior to submittal of Manuals.
- K. Provide a clearly labeled three-ring binder for Manuals having a thickness greater than 1/4-inch. Provide sheet lifters if binder is more than 2/3 full.
 - 1. Provide multiple binders for Manuals having a thickness greater than 2-inches.

PART 3 EXECUTION

3.01 GENERAL

- A. Provide information that may be requested without undue delay.
- B. Deliver O&M Manuals, when required, to the Engineer for review and approval and transmittal to the Owner.
 - 1. Do not start equipment unless the Owner has approved O&M Manuals.
- C. Properly lubricate all equipment prior to start-up.
- D. Work under sections requiring submittal of O&M Manual will not be considered complete and final payment will not be made until all Manuals have been submitted and approved.
- E. Provide revisions to O&M Manuals to reflect any changes made during installation and start-up of equipment.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

3.03 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01 40 00 Quality Requirements.

3.04 STARTING EQUIPMENT AND SYSTEMS

- A. Provide manufacturer's field representative to prepare and start equipment.
- B. Adjust for proper operation within manufacturer's published tolerances.
- C. Demonstrate proper operation of equipment to Owner's designated representative.

3.05 WARRANTY PERIOD

- A. Equipment warranties shall be a one (1)-year period after the Date of Substantial Completion unless otherwise specified.

END OF SECTION

SECTION 01 70 00
EXECUTION REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Examination, preparation, and general installation procedures.
- B. Requirements for alterations work, including selective demolition.
- C. Pre-installation meetings.
- D. Cutting and patching.
- E. Surveying for laying out the work.
- F. Cleaning and protection.
- G. Starting of systems and equipment.
- H. Demonstration and instruction of the Owner's personnel.
- I. Project Record Documents.
- J. Contract Closeout procedures, except payment procedures.

1.02 RELATED REQUIREMENTS

- A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, and Sections in Division 01 of these Specifications.
- B. Other requirements for technical services are stated in other sections of these Specifications.
- C. Section 00 65 19.13 - Contractor's Affidavit.
- D. Section 01 30 00 - Administrative Requirements: Submittals procedures.
- E. Section 01 40 00 - Quality Requirements: Testing and observation procedures.
- F. Section 01 78 00 - Closeout Submittals: Project record documents, operation and maintenance data, warranties and bonds.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
 - 1. On request, submit documentation verifying accuracy of survey work.
 - 2. Submit a copy of site drawing signed by the Land Surveyor, with elevations and locations of the work in conformance with Contract Documents.

3. Submit surveys and survey logs for the project record.
- C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
1. Structural integrity of any element of Project.
 2. Integrity of weather exposed or moisture resistant element.
 3. Efficiency, maintenance, or safety of any operational element.
 4. Visual qualities of sight exposed elements.
 5. Work of the Owner or separate Contractor.

1.04 QUALIFICATIONS

- A. For survey work, employ a land surveyor registered in South Carolina. Submit an evidence of Surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate.

1.05 PROJECT CONDITIONS

- A. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.
- B. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- C. Dust Control: Execute work by methods to minimize raising dust from construction operations.
- D. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
- E. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
1. Minimize amount of bare soil exposed at one time.
 2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
 3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
 4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
- F. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
- G. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

1.06 COORDINATION

- A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Notify affected utility companies and comply with their requirements.
- C. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- D. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- F. Coordinate completion and clean-up of work of separate sections.
- G. After the Owner's occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of the Owner's activities.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 60 00 Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work.
- B. Start of work means acceptance of existing conditions.
- C. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- D. Examine and verify specific conditions described in individual specification sections.

- E. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- F. Verify that utility services are available, of the correct characteristics, and in the correct locations.
- G. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 PREINSTALLATION MEETINGS

- A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify Alliance Consulting Engineers, Inc. four (4) days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
 - 1. Review conditions of examination, preparation and installation procedures.
 - 2. Review coordination with related work.
- E. Record minutes and distribute copies within two (2) days after meeting to participants, with two (2) copies to Alliance Consulting Engineers, Inc., Owners, participants, and those affected by decisions made.

3.04 LAYING OUT THE WORK

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Alliance Consulting Engineers, Inc. of any discrepancies discovered.
- C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- D. Promptly report to Alliance Consulting Engineers, Inc. the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Alliance Consulting Engineers, Inc.
- F. Utilize recognized engineering survey practices.

- G. Establish a minimum of two (2) permanent bench marks on site, referenced to established control points. Record locations, with horizontal and vertical data, on project record documents.
- H. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
 - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
 - 2. Grid or axis for structures.
- I. Periodically verify layouts by same means.
- J. Maintain a complete and accurate log of control and survey work as it progresses.

3.05 GENERAL INSTALLATION REQUIREMENTS

- A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.06 ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 - 1. Verify that construction and utility arrangements are as shown.
 - 2. Report discrepancies to Alliance Consulting Engineers, Inc. before disturbing existing installation.
 - 3. Beginning of alterations work constitutes acceptance of existing conditions.
- B. Remove existing work as indicated and as required to accomplish new work.
 - 1. Remove items indicated on drawings or described in the Technical Specifications.
 - 2. Relocate items indicated on drawings or described in the Technical Specifications.

- C. Services (Including but not limited to Fire Protection, Electrical and Telecommunications): Remove, relocate and extend existing systems to accommodate new construction.
 - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
 - 2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
 - 3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
 - b. Provide temporary connections as required to maintain existing systems in service.
 - 4. Verify that abandoned services serve only abandoned facilities.
- D. Protect existing work to remain.
 - 1. Prevent movement of structure; provide shoring and bracing if necessary.
 - 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 - 3. Repair adjacent construction and finishes damaged during removal work.
 - 4. Patch as specified for patching new work.
- E. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
 - 1. When existing finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Alliance Consulting Engineers, Inc.
- F. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.
- G. Clean existing systems and equipment.
- H. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.
- I. Do not begin new construction in alterations areas before demolition is complete.
- J. Comply with all other applicable requirements of this section.

3.07 CUTTING AND PATCHING

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. See Alterations article above for additional requirements.
 - 1. Complete the work.
 - 2. Fit products together to integrate with other work.
 - 3. Provide openings for penetration of mechanical, electrical and other services.
 - 4. Match work that has been cut to adjacent work.
 - 5. Repair areas adjacent to cuts to required condition.
 - 6. Repair new work damaged by subsequent work.
 - 7. Remove samples of installed work for testing when requested.
 - 8. Remove and replace defective and non-conforming work.
- C. Execute cutting and patching including excavation and fill to complete the work, to uncover work in order to install improperly sequenced work, to remove and replace defective or non-conforming work, to remove samples of installed work for testing when requested, to provide openings in the work for penetration of mechanical and electrical work, to execute patching to complement adjacent work, and to fit products together to integrate with other work.
- D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
- E. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- G. Restore work with new products in accordance with requirements of Contract Documents.
- H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- I. Patching:
 - 1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
 - 2. Match color, texture, and appearance.
 - 3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

- J. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
- K. Make neat transitions. Patch work to match adjacent work in texture and appearance. Where new work abuts or aligns with existing, perform a smooth and even transition.
- L. Patch or replace surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. Repair substrate prior to patching finish. Finish patches to produce uniform finish and texture over entire area. When finish cannot be matched, refinish entire surface to nearest intersections.

3.08 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.09 PROTECTION OF INSTALLED WORK

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Remove protective coverings when no longer needed; reuse or recycle plastic coverings if possible.

3.10 SYSTEM STARTUP

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
- C. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- D. Verify that wiring and support components for equipment are complete and tested.
- E. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- F. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.11 DEMONSTRATION AND INSTRUCTION

- A. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.

- B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- C. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of owner personnel.

3.12 ADJUSTING

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.13 FINAL CLEANING

- A. Execute final cleaning prior to final project assessment.
- B. Use cleaning materials that are nonhazardous.
- C. Clean site; sweep paved areas, rake clean landscaped surfaces.
- D. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.14 PROJECT RECORD DOCUMENTS

- A. Work includes:
 - 1. Throughout progress of the Work, maintain an accurate record of changes in the Contract Documents, as described in Article 3.1 below.
 - 2. Upon completion of the Work, deliver the recorded changes to the Engineer.
- B. Related work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, and Sections in Division 01 of these specifications.
 - 2. Other requirements affecting Project Record Documents may appear in pertinent other Sections of these specifications.
- C. Quality assurance:
 - 1. Delegate the responsibility for maintenance of Record Documents to one person on the Contractor's staff as approved by the Engineer.
 - 2. Accuracy of records shall be such that future search for items shown on the Project Record Documents may rely reasonably on the information provided under this Section of the Work.
- D. Submittals:
 - 1. The Engineer's approval of the current status of Project Record Documents may be a prerequisite to the Engineer's approval of requests for progress payment and request for final payment under the Contract.
 - 2. Prior to submitting each request for progress payment, secure the Engineer's approval of the current status of the Project Record Documents.

3. Prior to submitting request for final payment, submit the final Project Record Documents to the Engineer and secure their approval.
- E. Product handling:
1. Maintain Record Documents completely protected from deterioration and from loss and damage until completion of the Work and transfer to the Engineer.
 2. In the event of loss of recorded data, use means necessary to again secure the data to the Engineer's approval.
 - a. Such means shall include, if necessary in the opinion of the Engineer, removal and replacement of concealing materials.
 - b. In such case, provide replacements to the standards originally required by the Contract Documents.
- F. Job Set Documents:
1. Promptly following receipt of the Owner's Notice to Proceed, secure from the Engineer, at no charge to the Contractor, one complete set of all Documents comprising the Contract.
- G. Maintenance of Job Set:
1. Immediately upon receipt of the job set described in above paragraph titled "JOB SET DOCUMENTS", identify each of the Documents with the title, "RECORD DOCUMENTS - JOB SET".
 2. Preservation:
 - a. Considering the Contract completion time, the probable number of occasions upon which the job set must be taken out for new entries and for examination, and the conditions under which these activities will be performed, devise a suitable method for protecting the job set to the approval of the Engineer.
 - b. Do not use the job set for any purpose except entry of new data and for review by the Engineer.
 - c. Maintain the job set at the site of Work as that site is designated by the Engineer.
 3. Making entries on Job Set Drawings:
 - a. Use erasable colored pencil, preferably red (not ink or indelible pencil) to delineate changes.
 - b. Show by station number location of all fittings, manholes, valves, wye locations, etc.
 - c. Reference all fittings and valves to two aboveground items reasonably safe from being relocated and indicate such references on the drawings.
 - d. Show location of electrical conduit, pull boxes, etc.

4. Submittal:
 - a. Submit "marked-up" set of drawings to the Engineer.
 - i. Make any necessary additions as required by the Engineer.

3.15 CLOSEOUT PROCEDURES

- A. Work included shall be providing compliance with the requirements of the General Conditions of these Specifications for administrative procedures in closing out the project work.
- B. Make submittals that are required by governing or other authorities.
 1. Provide copies to Alliance Consulting Engineers, Inc.
 2. When the Engineer finds the Contractor's work acceptable, the Contractor shall be given such notice and should proceed with closeout submittals.
 3. Closeout submittals shall contain at least the following:
 - a. Project record documents.
 - b. Equipment operation and maintenance manuals and copies of start-up reports.
 - c. Warranties and bonds.
 - d. Spare parts and manuals.
 - e. Evidence of payment and release to liens per General Conditions.
 - f. Section 00 65 19.13 - Contractor's Affidavit.
- C. Notify Alliance Consulting Engineers, Inc. when work is considered ready for Substantial Completion.
 1. The Contractor shall notify the Engineer that, in their opinion, the project is substantially complete. A written statement listing items complete shall be submitted.
 2. Upon receipt of the Contractor's notice, the Engineer shall make an observation to determine if substantial completion is provided.
 3. If, in the Engineer's opinion, the project is not substantially complete, a written notice to the Contractor shall follow outlining reasons and deficiencies in work that comprised the Engineer's decision. The Engineer's decision shall be final.
- D. Request and obtain permit acceptance on all open construction permits.
- E. Submit written certification that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Alliance Consulting Engineers, Inc.'s review.
- F. Correct items of work listed in executed Certificates of Substantial Completion

and comply with requirements for access to Owners-occupied areas.

- G. Accompany Engineer & Owner on preliminary final observation.
 - 1. The Engineer will make a final observation for the Contractor after all items noted in the substantial completion observation have been corrected. The Contractor shall notify the Engineer in writing when a final observation is needed. Incomplete and/or defective work shall be given to the Contractor by written notice.
- H. Notify Alliance Consulting Engineers, Inc. when work is considered finally complete.
- I. Complete items of work determined by Alliance Consulting Engineers, Inc.'s final observation.
- J. Re-observation:
 - 1. Re-observation required due to failure by the Contractor to make previously noted corrections will be performed by the Engineer.
 - 2. Cost for such observations will be due to and payable by the Contractor at a rate equal to charges to the Owner for similar work.
 - 3. Re-observations will continue until the work is acceptable to the Engineer.
- K. Final Payment:
 - 1. Final payment to the Contractor will be made upon completion of the previous items and others required by these specifications. A final statement shall be forwarded to the Engineer. The statement shall address:
 - a. Previous change orders.
 - b. Unit prices.
 - c. Deductions for un-corrected work.
 - d. Deductions for liquidated damages.
 - e. Deductions for re-testing work.
 - f. Deductions for re-observation.
 - g. Deductions for shop drawing review.
 - h. Adjusted contract sum.
 - i. Previous payments.
 - j. Amount due.
 - 2. When required, the Engineer will prepare a contract change order for adjustments not previously made.

END OF SECTION

SECTION 01 71 23

FIELD ENGINEERING

PART 1 GENERAL

1.01 DESCRIPTION

- A. Work included: Provide such field engineering services as are required for proper completion of the Work.

1.02 Related work:

- B. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions and Sections in Division 01 of these Specifications.

1.03 QUALITY ASSURANCE

- A. Provide competent labor, supervision, inspection services, testing services, materials and equipment for a complete and quality project.
- B. Exercise proper precautions to verify the information described in the Technical Specifications and Contract Documents prior to laying out or performing any part of the Work.
 - 1. The Contractor will be held responsible for any errors therein that otherwise might have been avoided.
 - 2. Promptly inform the Engineer of any errors or discrepancies discovered in the Technical Specifications in order that proper corrections may be made.

1.04 PROCEDURES

- A. Secure all required permits and make all required and necessary notifications before starting work on the site.
- B. Perform preparation, coating and repair task during progress of the Work consistent with the spirit of the Technical Specifications.
- C. Do not deviate from or change items of the Work without specific approval from the Engineer.
- D. Promptly advise the Engineer when a change becomes necessary because of other changes in the Work.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

SECTION 01 74 19

WASTE MANAGEMENT

PART 1 GENERAL

1.01 WASTE MANAGEMENT REQUIREMENTS

- A. The Owner requires that this Project generate the least amount of trash and waste possible.
- B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
- C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.
- D. Methods of trash/waste disposal that are not acceptable are:
 - 1. Burning on the project site.
 - 2. Burying on the project site.
 - 3. Other illegal dumping or burying.
- E. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.02 DEFINITIONS

- A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.
- B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.
- C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.
- D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.
- E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.
- F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
- G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.
- H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

- I. Return: To give back reusable items or unused products to vendors for credit.
- J. Reuse: To reuse a construction waste material in some manner on the project site.
- K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.
- L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.
- M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.
- N. Toxic: Poisonous to humans either immediately or after a long period of exposure.
- O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

PART 2 PRODUCTS

2.01 No products are required under this Section.

- A. See Section 01 60 00 - Product Requirements for substitution submission procedures.
- B. For each proposed product substitution, submit the following information in addition to requirements specified in Section 01 60 00 Product Requirements:
 - 1. Relative amount of waste produced, compared to specified product.
 - 2. Cost savings on waste disposal, compared to specified product, to be deducted from the Contract Sum.
 - 3. Proposed disposal method for waste product.
 - 4. Markets for recycled waste product.

PART 3 EXECUTION

3.01 WASTE MANAGEMENT PROCEDURES

- A. See Section 01 30 00 Administrative Requirements for additional requirements for project meetings, reports, submittal procedures and project documentation.
- B. See Section 01 60 00 Product Requirements for waste prevention requirements related to delivery, storage and handling.
- C. See Section 01 70 00 Execution Requirements for trash/waste prevention procedures related to demolition, cutting and patching, installation, protection and cleaning.

3.02 WASTE MANAGEMENT PLAN IMPLEMENTATION

- A. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse and return methods to be used by all parties at the appropriate stages of the project.
- B. Meetings: Discuss trash/waste management goals and issues at project meetings.
 - 1. Pre-bid meeting.
 - 2. Pre-construction meeting.
 - 3. Regular job-site meetings.
- C. Reuse of Materials On-Site: Set aside, sort and protect separated products in preparation for reuse.
- D. Salvage: Set aside, sort and protect products to be salvaged for reuse off-site.

END OF SECTION

SECTION 01 75 16

START-UP REQUIREMENTS

PART 1 GENERAL

1.01 DESCRIPTION

- A. Work included: Provide personnel to place all equipment in operation and instruct Owner's personnel in operation and maintenance procedures.
- B. Related work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, and Sections in Division 01 of these specifications.
 - 2. Other provisions concerning Start-up Services may also be stated in other Sections of these specifications.

1.02 QUALITY ASSURANCE

- A. Use adequate numbers of skilled personnel who are thoroughly trained and experienced in the necessary procedures and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Provide manufacturers technical services as specified or needed for start-up.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 GENERAL

- A. Contractor shall be responsible for obtaining a certificate of substantial completion for all components which will include but is not limited to all required testing, approved record drawings, Engineer's Certificate of Completion, Owner's Certificate of Completion and a Permit to Operate from SCDHEC.

3.02 SCHEDULING

- A. Determine date of start-up jointly with Engineer and Owner.
- B. Schedule services of manufacturer's technical personnel jointly with Engineer prior to date of start-up.

3.03 FIELD MEASUREMENTS

- A. Measure and record that all installed metering and telemetry is functioning per manufacturer's requirements.
- B. Include all records in the start-up report.

3.04 COMPLETION

- A. Start-up services will not be considered completed until all equipment is operating properly and equipment is functioning as designed.

END OF SECTION

SECTION 01 78 00

CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Project Record Documents.
- B. Operation and Maintenance Data.
- C. Warranties and Bonds.

1.02 RELATED REQUIREMENTS

- A. Section 00 70 00 – Standard General Conditions of the Construction Contract: Performance bond and labor and material payment bonds, warranty, and correction of work.
- B. Section 01 30 00 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- C. Section 01 70 00 - Execution Requirements: Contract closeout procedures.
- D. Individual Product Sections: Specific requirements for operation and maintenance data.
- E. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

- A. Project Record Documents: Contractor to keep Record Documents on site at all times for review by Engineer or Owner. Submit documents to Alliance Consulting Engineers, Inc. with claim for final Application for Payment.
- B. Operation and Maintenance Data:
 - 1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Alliance Consulting Engineers, Inc. will review draft and return one copy with comments.
 - 2. For equipment, or component parts of equipment put into service during construction and operated by the Owners, submit completed documents within ten days after acceptance.
 - 3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Alliance Consulting Engineers, Inc. comments. Revise content of all document sets as required prior to final submission.
 - 4. Submit two sets of revised final documents in final form within 10 days after final inspection.

- C. Warranties and Bonds:
1. For equipment or component parts of equipment put into service during construction with the Owners permission, submit documents within 10 days after acceptance.
 2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
1. Drawings.
 2. Addenda.
 3. Change Orders and other modifications to the Contract.
- B. Ensure entries are complete and accurate, enabling future reference by the Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress.
- E. Record Drawings: Legibly mark each item to record actual construction including:
1. Field changes of dimension and detail.
 2. Details not on original Contract drawings.

3.02 OPERATION AND MAINTENANCE DATA

- A. For Each Product or System: List names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE MANUALS

- A. Prepare instructions and data by personnel experienced in maintenance and operation of described products.
- B. Prepare data in the form of an instructional manual.

3.04 WARRANTIES AND BONDS

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with The Owners permission, leave date of beginning of time of warranty until the Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.

END OF SECTION

SECTION 02 30 00

SUBSURFACE EVALUATION

PART 1 GENERAL

1.01 DESCRIPTION

- A. Subsurface Evaluation Report:
 - 1. Report of Subsurface Exploration Entrance Road to Clarendon County Industrial Park – Roadway – Prepared for the Project by S&ME, Inc. dated February 1, 2023 (S&ME, Inc. Project No.: 218770)
 - 2. Report of Subsurface Exploration Entrance Road to Clarendon County Industrial Park – Pump Station – Prepared for the Project by S&ME, Inc. dated February 1, 2023 (S&ME, Inc. Project No.: 218770)
 - a. A copy of these reports are included in this Section 02 30 00.
- B. Use of data:
 - 1. These reports were obtained only for the Engineer's use in design and is not a part of the Contract Documents.
 - 2. The report is available for bidders' information, but is not a warranty of subsurface conditions.
 - 3. It is the responsibility of the Bidders to visit the site and acquaint themselves with the existing conditions.
 - 4. Prior to bidding, bidders may make their own Subsurface Investigations to satisfy themselves as to site and subsurface soil conditions, but these investigations must be performed under the time schedules and arrangements that have been approved in advance by the Engineer.

1.02 QUALITY ASSURANCE

- A. 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, as specified in Section 01 40 00.
- B. All work that is performed under this contract that does not meet technical or design requirements must be adjusted and no deviation from the Contract Documents can be made without specific and written approval from the Engineer.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION



Report of Geotechnical Exploration
Entrance Road to Clarendon County Industrial Park – Pump
Station
Manning, Clarendon County, South Carolina
S&ME Project No. 218770

PREPARED FOR:

Alliance Consulting Engineers, Inc.
PO Box 8147
Columbia, South Carolina 29202

PREPARED BY:

S&ME, Inc.
134 Suber Road
Columbia, South Carolina 29210

February 1, 2023



February 1, 2023

Alliance Consulting Engineers, Inc.
PO Box 8147
Columbia, South Carolina 29202

Attention: Ms. Susan MacRae

Reference: **Report of Geotechnical Exploration**
Entrance Road to Clarendon County Industrial Park – Pump Station
Manning, Clarendon County, South Carolina
S&ME Project No. 218770

Dear Ms. MacRae:

As requested, S&ME, Inc. has completed field testing for the proposed pump station for the Clarendon County entrance roadway, in Clarendon County, South Carolina. Our work was performed in general accordance with our proposal, S&ME Proposal No 218770 Revision 3, dated November 28, 2022. This report includes the recommendations for the pump station portion of this project, the exploration of the roadway portion of the project is provided under separate cover.

This report provides information on the exploration and testing procedures used, our boring records and our conclusions regarding site conditions and our recommendations regarding excavation considerations (including difficult excavation and temporary shoring), dewatering considerations, suitability of on-site soils for use as structural fill, fill placement and compaction, lateral earth pressures, shallow foundation support (including allowable bearing pressure, anticipated settlement, and hydrostatic uplift considerations).

S&ME appreciates this opportunity to work with you as your geotechnical engineering consultant on this project. Please contact us at (803) 561-9024 if you have questions or need additional information regarding this report.

Sincerely,

S&ME, Inc.

Kara Fugate, E.I.T.
Associate Project Manager



Robert C. Bruorton, P.E.
Senior Engineer/Principal Project Manager





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1.0 Project Information

Project information was initially provided by Susan MacRae (Alliance) to Chad Bruorton, P.E. (S&ME) in email correspondence on September 16, 2021. Ms. MacRae's correspondence included a Clarendon County GIS aerial photograph annotated with the anticipated roadway alignment. Further information was provided in email correspondence from Ms. MacRae to Mr. Bruorton on September 30, 2022, that included the *Conceptual Site Plan +/- 100,000-SF Speculative Building No. 9*, prepared by Alliance Consulting Engineers, dated September 27, 2022. Additional information was provided by Ms. MacRae during a telephone conversation with Mr. Bruorton on November 16, 2022, in which it was requested that we perform an exploration within the proposed pump station.

The project site is located at the eastern termination of the existing Joe Rogers Jr Boulevard, in Manning, Clarendon County, South Carolina, as shown on the *Site Location Plan*, attached as Figure 1 in Appendix I. We understand that the project consists of the construction of a roughly 10-foot deep, new pump station to be located northwest of the proposed cul-de-sac of the new roadway.

From our review of Google Earth mapping, existing grades across the site appear to slope from east to west and range from roughly elevation 137 to 133 feet.

2.0 Exploration Procedures

The subsurface exploration of this project included one (1) Standard Penetration Test (SPT) soil test boring. The approximate boring location is shown in the *Boring Location Plan*, attached as Figure 2 in Appendix I.

2.1 Reconnaissance of Project Area

On January 9, 2023, a representative from S&ME visited the site to observe current site conditions and lay out the proposed soil test boring location. The soil test boring location was laid out by estimating the location of the proposed well location based on the provided drawing using our GPS equipment. The boring location and elevation indicated on the attached *Boring Location Plan* and boring log must be considered as approximate. No formal survey of boring locations or elevations was conducted by S&ME.

2.2 Field Testing and Sampling

The following sections detail our field and sampling activities at the site.

2.2.1 Standard Penetration Test (SPT) Soil Boring

One (1) soil test boring (B-1) with SPT sampling and testing was performed on January 9, 2023. The SPT soil test boring was performed by Mid Atlantic Drilling under subcontract to S&ME, using an ATV-mounted CME 45C drill rig. The boring was advanced using mud rotary techniques to a termination depth of roughly 35 feet below the existing ground surface.



Split-spoon samples and Standard Penetration Test Resistance N-values were obtained at selected intervals in general accordance with ASTM D1586. Representative samples of the soils obtained by the split-spoon sampler were collected and placed in suitably identified, sealed glass jars and transported to our laboratory.

2.2.2 *Ground Water Measurement*

Measurement of ground water was attempted in the boring shortly after drilling was completed. Once drilling was completed, the borehole was left open to allow for delayed ground water measurements after a period of approximately 24 hours. After ground water measurements, the borehole was backfilled with auger cuttings and coarse aggregate as needed, and a plastic hole plug was placed within the borehole at a depth of roughly 2 feet below the ground surface.

3.0 **Site Conditions**

S&ME's assessment of the geotechnical conditions began with a reconnaissance of the topography and physical features of the site. We also consulted various available topographic and geologic maps for relevant information.

3.1 **Surface Conditions**

The site is generally level with the exception of an existing ditch along the east side of the site. The surface was covered in agricultural soils and debris.

3.2 **Subsurface Conditions**

Recovered field samples and the field boring log was reviewed in the laboratory by a member of our geotechnical staff. The soil test boring record and other field data are assembled in Appendix II.

3.2.1 *Site Geology*

Manning, South Carolina lies immediately southeast of a topographical feature termed the Citronelle Escarpment. The escarpment denotes the boundary between the upper and middle portions of the Atlantic Coastal Plain of South Carolina and is a major topographical feature of the Coastal Plain. The area northwest of the escarpment is termed the Santee Hills and is underlain by Tertiary age Coastal Plain soils. Areas southeast of the escarpment, lie within the Atlantic Flatwoods Region of the Lower Coastal Plain of South Carolina.

The Atlantic Flatwoods comprises most of the Lower Coastal Plain, extending to the Surry Escarpment 15 to 40 miles inland from the sea. The topography of this region is dominated by up to six archaic marine terraces, exposed above sea level by uplifting of the local area over the last one million years. The terraces exhibit minor surface erosion but can be traced large distances on the basis of surface elevation. Abandoned tidal eddies on the terraces have been filled with sediments and now form shallow, poorly drained elliptical depressions on the surface, termed Carolina Bays, which are commonly apparent on aerial photographs or local topographic maps. Materials comprising the terraces typically consist of a strand or beach ridge deposit of clean sands at the seaward margin, interbedded with progressively more fine grained soils to the west. The marine terraces form a thin veneer over older, underlying Coastal Plain marl.



3.2.2 *Interpreted Subsurface Profile*

The generalized subsurface conditions at the site are described below. The discussed subsurface descriptions are of a generalized nature to highlight the major subsurface stratification features and material characteristics. The boring record included in Appendix II should be reviewed for specific information at the boring location. The depth and thickness of the subsurface strata indicated on the boring record were estimated based on the drill cuttings and the samples recovered. The transition between materials may be more gradual than indicated on the boring record. Information on actual subsurface conditions exists only at the specific boring location and is relevant to the time the exploration was performed. Variations may occur and should be expected at locations remote from the boring. The stratification lines were used for our analytical purposes and, unless specifically stated otherwise, should not be used as the basis for design or construction cost estimates. The soil test boring record is attached in Appendix II.

Surface Materials - "Plow Zone" Soils

At the existing ground surface, the boring encountered an agricultural "plow zone". The "plow zone" was measured to be roughly 10 inches thick. "Plow Zone" soils are typically encountered in areas used for agricultural purposes and influenced by cycles of discing and growing of crops. "Plow zone" soils are typically dark brown or gray and contain varying amounts of organics.

Coastal Plain Deposits

Beneath the "Plow Zone" soils in the soil boring, native Coastal Plain deposits were encountered extending to the termination depth of 35 feet below the existing ground surface. The native deposits consisted of fine to medium sands with few to some low to medium plasticity fines (SC or SM). Recovered samples were generally orange, grey, and yellow in color and were moist to wet to the touch.

SPT N-values in these soils ranged from "WOH", or weight of hammer where only the weight of the hammer is required to advanced the sampler the full sample depth, to 22 blows per foot (bpf). This indicates a very loose to medium dense relative density within the sands.

Groundwater

Ground water was encountered at the time of boring at a depth of approximately 3½ feet below the existing ground surface. Ground water measurements were attempted after a period of 24 hours. At that time, ground water was measured at roughly 4 feet below the existing ground surface.

Based upon our understanding of the project, it appears that ground water will impact construction on this site. However, we note that ground water levels are influenced by precipitation, long term climatic variations, and nearby construction. Measurements of ground water made at different times than our exploration may indicate ground water levels substantially different than indicated on the boring record in Appendix II.



4.0 Conclusions and Recommendations

The analyses and conclusions submitted herein are based, in part, upon data obtained from the boring location. Subsurface conditions across the site will vary, as will grading and construction details. Based on the results of our exploration, the following paragraphs include our conclusions and recommendations regarding excavation considerations, dewatering considerations, suitability of on-site soils for use as structural fill, fill placement and compaction, lateral earth pressure parameters, and shallow foundation support (including allowable bearing pressure, anticipated settlement, and hydrostatic uplift considerations).

From the project information, we understand the proposed wet well of the pump station will be roughly 10 feet below the existing ground surface. Therefore, it appears that dewatering and foundation subgrade remediation will be necessary to construct and support the planned structure.

4.1 Dewatering Considerations

As previously discussed, due to the observed ground water level in our boring and the planned depth of the wet well excavation, construction will be impacted. The observed ground water level in our boring suggests that the planned bottom of wet well excavation will extend below the observed ground water level, therefore dewatering techniques will be required at the site. Possible options for dewatering the wet well excavation include, but are not limited to:

- Sump and Pump,
- Vacuum Well Point.

The method best suited for the project will depending on excavation type, duration of time the wet well excavation is to remain open during construction and magnitude of in-flow of ground water into the excavation. The following sections provide general guidelines on each of these dewatering options. Regardless of the method employed, we recommend that the ground water level be lowered to an elevation corresponding to at least two feet below the planned bottom of excavation and maintained at that level until foundation construction is completed.

4.1.1 *Sump and Pump*

Adequate construction dewatering may be accomplished by pumping from deep-cased sumps backfilled with washed stone. Sumps should be pumped continuously for many days or weeks prior to excavation to lower the groundwater level prior to excavation. Generated groundwater is then pumped to a discharge point.

Continue dewatering during construction and fill placement to maintain groundwater at its lowered elevation. If discontinued prematurely, the ground water level will rise, filling the working area of the excavation and saturating the fill soils which will prevent effective compaction. When the excavation has been filled more than two feet above the natural groundwater level, dewatering may be discontinued.



4.1.2 Temporary Vacuum Well Point Dewatering

Well points are essentially shallow wells, which are installed by jetting/pumping water at high pressure through a steel placing tube, or as self-jetting well points where high-pressure water is pumped directly down the riser. Individual well points are normally 4 to 6-inches in diameter. The spacing and depths of the bores is dependent on the ground conditions and drawdown requirements, but typical spacing is between 3 and 10 feet apart. Installed well points are then coupled by control swings to a horizontal vacuum header (collection) main. The header main in turn is connected to a 4 to 6-inch centrifugal or piston vacuum pump. An individual pump can typically handle from 25 to 60 well points on a single header. Generated groundwater is then pumped to a discharge point.

The close spacing of the well points and use of vacuum is often preferable to deep well pumps in fine graded soils or highly stratified soils, where flow is preferentially in the horizontal direction. The disadvantage is the limited suction lift, between 10 to 20 feet, which makes multiple levels of well points necessary for deeper drawdown. Based on our understanding of the planned depth of excavation for the wet well, multiple levels of well points may be necessary to achieve the required draw down. An additional disadvantage is the requirement for surface piping around the excavation, which can interfere with access to the pit, and which must be protected. Commonly well points are regarded as 'disposable' and are left in place after the excavation is filled.

In developing design criteria for a vacuum well point system, the actual spacing should be determined by requesting a cost proposal from selected specialty contractors experienced with this method. The proposal should be evaluated by the design engineers, and a contractor should be selected after any necessary negotiations.

4.1.3 Dewatering Considerations

General site dewatering can sometimes cause settlement of adjacent structures/roadways due to an increase in effective stresses which can consolidate soils. Based on the available data, we anticipate that this should not be a problem at this site. Pumping of fine soil particles due to improper dewatering techniques can result in unwanted subsidence. Therefore, proper dewatering systems should be implemented to reduce these effects.

4.2 Excavation Considerations

Soil test boring data leads us to anticipate that very loose to medium dense relative density sandy deposits will mostly be encountered during general excavation of the wet well. Coastal Plain deposits consisting of these type soils can be typically excavated using backhoes, provided the excavation area is dewatered. The degree of difficulty that mobile equipment will encounter rises dramatically in materials exceeding about 70 to 80 blows per foot. These conditions were not encountered in our soil boring.

If the wet well is to be constructed as a caisson, our experience indicates that conventional drilled shaft rigs equipped with an earth auger can typically penetrate Coastal Plain deposits similar to those encountered. The use of temporary casing and/or drilling slurry may be necessary due to the observed groundwater depth and sloughing of less cohesive sands.



4.2.1 Temporary Excavation Stability

Excavations shall be sloped or shored in accordance with local, state, and federal regulations, including OSHA (29 CFR Part 1926) excavation trench safety standards. The contractor is usually solely responsible for site safety. This information is provided only as a service, and under no circumstances shall S&ME be assumed to be responsible for construction site safety.

4.2.2 Excavation Slopes

Open/sloped cut excavations are an option for the construction of the wet well. Based upon our experience and information obtained by boring at the site, we recommend the excavated cut slopes not exceed a maximum inclination of 2H:1V (horizontal:vertical). These values are for planning purposes and will need to be confirmed during construction by direct observation of the excavated slopes, and inclinations modified, if necessary, based on the observed conditions. If these slopes are to be exceeded, then temporary/permanent retainage will be necessary.

Recommended slopes are preliminary and assume that groundwater is controlled at the lowest level of the excavation continuously while the excavation is open. Groundwater is assumed not to flow or emerge from soil excavation slopes. Surface water is assumed to be captured by appropriate drainage measures above the slope crest and not allowed to drain down the slope. If groundwater is observed emerging from the face of the slope or if surface water is adversely affecting the slope, S&ME should be contacted immediately. It is also assumed that excavated slopes are relatively uniform such that local slopes do not significantly exceed the recommended slopes. Finally, the recommended slope inclination assumes that all slopes are monitored for indications of instability and that slopes are flattened or other measures taken if appropriate. Monitoring of the slopes during construction is presently not part of our contracted scope of services for this project.

4.2.3 Temporary Retaining Structures

Open/shored cut excavations are another option for the construction of the wet well. In this case, temporary retaining structures will be required to hold the excavation open for construction. Design of temporary retaining structures for vertical or near-vertical excavations, was beyond our scope. Typically, such designs are done by specialty contractors working directly for the general contractor. Contractor's and designer's responsibilities for design and construction of temporary bracing need to be clearly defined in the contract documents. Some options of temporary retaining structures typical for a scenario similar to this project may include steel sheet piles, soil nails, or soldier piles with lagging.

If the wet well is to be constructed as a caisson, temporary retainage should consist of removable steel casing to prevent influx of groundwater and caving of the excavation sides due to soil relaxation or sloughing of very loose sands. Steel casing should be extended to the planned bottom depth.

4.3 Use of On-site Soils as Structural Fill

The on-site soils that may be proposed for use as fill at the site generally have USCS soil classification of sands with varying amounts of fines (SM and SC).



Coarse grained soils with varying amounts of fines (SM and SC), similar to those encountered at the site, are typically suitable for use as structural fill. Before beginning to place fill, sample and test each proposed fill material to determine maximum dry density, optimum moisture content, natural moisture content, gradation and plasticity of the soil.

Although suitable for use as structural fill, it is important to note that clayey sandy (SC) soils can be moisture sensitive to some degree due to their higher plasticity fines content, and therefore, can be difficult to work if allowed to become wet. These difficulties can include softening of exposed subgrade soils, excessive rutting or deflection under construction traffic, and the difficulty associated with adequately drying and compacting wet soil. Moisture-related earthwork difficulties can be reduced by performing the earthwork during the typically drier months of the year (May through October).

4.4 Fill Placement and Compaction

Structural soil fill material should have less than 5 percent organic matter, a standard Proctor maximum dry density of 90 pcf or greater and a plasticity index (PI) of 30 percent or less. We recommend that off-site borrow meet the organic content, PI and density requirements of this section. Testing will be required before fill placement begins to determine the optimum moisture-density condition for the fill materials. Material to be used as soil fill should be tested and approved by the geotechnical engineer before being placed.

4.4.1 Density and Moisture Requirements

Place fill in maximum 8-inch loose lifts and compact to at least 95 percent of maximum dry density (ASTM D698 standard Proctor). Fill moisture content should be maintained within +/- 3 percent of the optimum moisture content. Contractor should be prepared to wet or dry soils as necessary to achieve compaction.

4.4.2 Fill Placement Near Ground Water Elevation

Due to measured ground water level in our boring, special care should be taken during fill placement activities. Where fill will be placed at or near ground water elevations, the static setting of the roller should be used. The use of the static setting will minimize the capillary action created from an increased pore-water pressure of the underlying saturated soils, which is most commonly created with the use of a vibratory setting of the roller. This will ultimately minimize the saturation of the fill soils and the degradation of previously placed fills.

4.4.3 Compaction of Granular Soils

A vibratory sheeps-foot roller will likely be most effective for compaction of the near surface silty/clayey sandy (SM and SC) soils encountered at the sites. Sheeps-foot compactors will likely be preferable because the pads better penetrate the soil and they tend to break down the natural cohesive bonds between the particles.

Sandy soils excavated above the water table are usually close enough to optimum moisture content to place and compact efficiently with little moisture conditioning required. Soils that are initially too wet or are allowed to become wet due to rainfall are more difficult to use.



4.4.4 *Monitoring and Testing*

Fill placement should be witnessed by an experienced soils technician working under the guidance of the geotechnical engineer. We recommend full time observation by a qualified soils technician with testing at random intervals to confirm compaction is being achieved.

4.5 **Lateral Earth Pressures**

The earth pressure coefficients given below are recommended for in-situ (if excavation shoring is employed) or backfill (if open-cut methods are used) behind subgrade walls. We recommend that the "At rest" lateral earth pressure coefficient be used if the walls will be restrained from rotation and that the "Active" lateral earth pressure coefficient be used if rotation is not restrained. For walls that will not rotate or translate, such as pit walls or other walls rigidly connected to structures, at-rest conditions will develop. However, if walls will be backfilled before they are braced internally, then the wall design must be checked assuming a fully cantilevered support condition using the active earth pressure profile. In addition to the lateral loads exerted by the soil against the walls, allowance should be included for lateral stresses imposed by any temporary or long-term surcharge loads, such as cars or trucks adjacent to the walls.

Assuming a conventional Rankine or Coulomb analysis of soil pressures, active and at-rest fluid pressures assume a triangular distribution of stress behind the wall, with the lateral pressure exerted against the wall given by the equivalent fluid pressure value times the depth to that point. For the drained values to be applicable, walls must be properly detailed to provide toe drains or weep holes to remove infiltrating water by gravity. If walls cannot be drained, hydrostatic pressure must be added to the design fluid pressures.

4.5.1 *Open Cut Backfill*

The values given in the following table assume placement and compaction of the backfill in accordance with recommendations elsewhere in this report. These values assume backfill generally classified as SM or SC soils, assumed to be consistent with the excavation spoils generated during wet well construction, according to the Unified Soil Classification system, as described in Table 1610.1 of the 2018 IBC.

The values in the table below are for open-cut and backfill during wet well construction, based on a moist unit weight of 120 pcf, friction angle of 28 degrees, and 100 psf cohesion, representative of suitable fill soils. If fill soils are imported for use as backfill, they should be evaluated for conformance with the properties listed herein.



Table 4-1 – Earth Pressure Coefficients – Backfill

Support Condition (All conditions assume level backfill)	Earth Pressure Coefficients
	Fill (Open-cut)
K _a , Active Condition (Wall deflects laterally, as with a conventional cantilevered retaining wall)	0.36
K _o , At-rest Condition (Wall restrained from movement, as with a basement wall)	0.53
K _p , Passive Condition (Wall movement toward retained soil, as with a thrust block)	2.77
Coefficient of Sliding Friction (Tan λ)	0.34

- The above values represent a fully drained soil condition, as defined in IBC 2018. Where backfill soils are not drained using an appropriately designed toe drainage system, the lateral soil pressure must consider hydrostatic forces below the surface, and submerged soil unit weight.
- Grade walls lower than 8 feet high are not considered relatively rigid or restrained walls.
- Organic silts (OL or OH), inorganic elastic silts (MH), or inorganic highly plastic clays (CH) soils may not be used as backfill.
- Compact backfill directly behind walls with light, hand-held compactors. Heavy compactors and grading equipment should not be allowed to operate within 10 feet of the walls during backfilling to avoid developing excessive temporary or long-term lateral soil pressures.

4.5.2 *In-Situ with Excavation Shoring*

The soil parameters for the existing in-situ soils encountered in our boring for use in temporary and permanent shoring/retainage are presented in the following table:

Table 4-3 – Earth Pressure Coefficients

Soil Layer	Moist Unit Weight (pcf)	Submerged Unit Weight (pcf)	Friction Angle (°)	Cohesion (psf)	Earth Pressure Coefficients		
					K _a	K _o	K _p
Clayey Sand (SC) (0 to 3 feet)	100	37.6	28	-	0.36	0.53	2.77
Clayey Sand (SC) (3 to 5 feet)	110	47.6	29	-	0.35	0.52	2.88
Clayey Sand (SC) (5 to 10 feet)	120	57.6	33	-	0.29	0.46	3.39
Silty Sand (SM) (10 to 15 feet)	100	37.6	29	-	0.35	0.52	2.88
Clayey Sand (SC) (15 to 20 feet)	100	37.6	28	-	0.36	0.53	2.77



We recommend a Coefficient of Sliding Friction ($\tan \lambda$) at the base of this wet well excavation for the poorly graded sand (SP) of 0.34.

4.6 Shallow Foundation Design and Construction

Based on our boring data and experience in the area, assuming the site preparation recommendations provided above have been followed, shallow foundations appear suitable for support of the proposed wet well structure.

4.6.1 Bearing Elevation Stabilization

From our boring data, it appears that medium dense, sandy deposits will be encountered at the base of the excavation at the site. Due to their location below the existing ground water level observed in our boring, stabilization activities will likely be necessary to provide a stable working base. Based on on-site observations of the excavation, we recommend that in the event very loose, wet, sandy soils are encountered they be over-excavated roughly 2 feet, and the resulting excavation base be inspected to determine if further over-excavation is required to provide a stable base for fill placement. If the base is stable, the over-excavation should be backfilled with graded aggregate base course (GABC) materials up to the required bearing elevation. The GABC should be placed in 6 to 8-inch lifts and be compacted to at least 95 percent of the modified Proctor maximum dry density (ASTM D1557).

4.6.1 Allowable Bearing Pressure

Assuming proper design and construction, an allowable bearing pressure of 3,000 pounds per square foot (psf) or less is recommended for a mat foundation bearing on either the 22 bpf sand or GABC placed to replace unstable sands and compacted as recommended above at planned bottom of wet well depth. Excavated footings should be examined by the geotechnical engineer or representative of the geotechnical engineer prior to placement of concrete to determine that variations in the soil do not lower the allowable bearing capacity. It may be necessary to redesign footings in the field (e.g. widen or deepen footings) based on observed conditions.)

4.6.2 Settlement

Structural loading conditions for the planned wet well were not provided at the time of this report. Therefore, we assumed the wet well could consist of a 6-foot by 6-foot mat foundation and 8-inch thick sidewalls, constructed of reinforced concrete. From our computations utilizing the assumed maximum loading conditions (approximately 28,000 pounds uniform vertical loading) and dimensions presented in this report, total anticipated settlement for a properly constructed mat foundation will be one inch or less for the assumed 6-foot by 6-foot mat foundation and 600 to 1,000 psf maximum contact pressure. Differential settlement across the mat foundation carrying similar loads is estimated as less than one half of the total settlement.

Deformation or bending of the mat foundation under concentrated loading will depend on mat stiffness and reinforcing as well as soil-mat interaction. Considering a "beam on elastic subgrade" or Winkler approach in design of footing reinforcing, a modulus of subgrade reaction of 4 to 7 psi/in may be assumed for computation of soil resistance to beam deflection.



4.6.3 *Settlement Time Rate*

We estimated time rate of settlement using our general experience in similar soils in the Coastal Plain region. A large portion of soil compression will occur elastically upon placement of fill or structure loads. Although the soils loaded by the footings lie below the water table, if the bearing elevation stabilization recommendations above are followed, time for primary consolidation to occur in the underlying sandy soils is likewise very short and settlements associated with secondary compression are negligible. We estimate that approximately 90 percent of total settlements estimated above will occur with load placement. Remaining settlements are expected to largely occur within the next 5 to 7 days.

4.6.4 *Hydrostatic Uplift on Foundations*

Water was encountered at a depth of approximately 4 feet below the existing ground surface (or roughly 6 feet above the planned bottom of wet well), therefore, after dewatering techniques have subsided and construction is complete, it is assumed that ground water will stabilize back to this depth, which will be above the base of the wet well. Design of the structure must therefore adequately resist the anticipated uplift due to hydrostatic pressures. As an alternative to designing for uplift, a permanent dewatering system should be installed.

We recommend a minimum factor of safety of 1.25 be provided against uplift when utilizing dead load for resistance. If adequate uplift resistance cannot be obtained from the weight of the foundations and dead loads of the structure or economically obtained by increasing these weights, we recommend utilizing either a screw-type anchor system or tie-downs. The groundwater levels should be further evaluated at the time of construction to verify the water levels. We recommend that all below grade walls for structures be properly waterproofed.

4.6.5 *Foundation Lateral Capacity*

Lateral capacity of footings includes a soil lateral pressure and coefficient of friction as described in IBC Section 1806. Where bearing in natural soils, footings will be embedded in material mostly similar to those described as Class 4 in Table 1806.2. Where footings are cast neat against the sides of excavations in natural soils, an allowable lateral bearing pressure of 150 psf per foot depth below natural grade may be used in computations.

A coefficient of friction of 0.25 multiplied by the dead load may be used to calculate lateral sliding resistance. An increase of one-third in the allowable lateral capacity may be considered for load combinations, including wind or earthquake, unless otherwise restricted by design code provisions.

4.6.6 *Construction and Observation of Footings*

When possible, concrete should be placed the same day footings are excavated to the planned bearing elevations. Remove soils softened by water intrusion or exposure before placing concrete. We recommend placing a 2- to 3-inch "mud mat" of lean (2000 psi) concrete in the bottom of the excavation to protect the bearing soils and provide a stable working surface for rebar installation. (The bearing grade will need to be slightly over-excavated a few inches to make sure the mud mat does not extend higher than the plan bottom-of-footing elevation.) The geotechnical engineer or a representative of the geotechnical engineer should observe cleaned footing excavations prior to concrete placement. S&ME should also observe undercut areas prior to backfilling to confirm that poor soils have been removed and that the exposed subgrade is suitable for support of footings.



5.0 Qualifications of Report

This report has been prepared in accordance with generally accepted geotechnical engineering practice for specific application to this project. The conclusions and recommendations contained in this report are based upon applicable standards of our practice in this geographic area at the time this report was prepared. No other representation or warranty either express or implied, is made.

We relied on project information given to us to develop our conclusions and recommendations. If project information described in this report is not accurate, or if it changes during project development, we should be notified of the changes so that we can modify our recommendations based on this additional information if necessary.

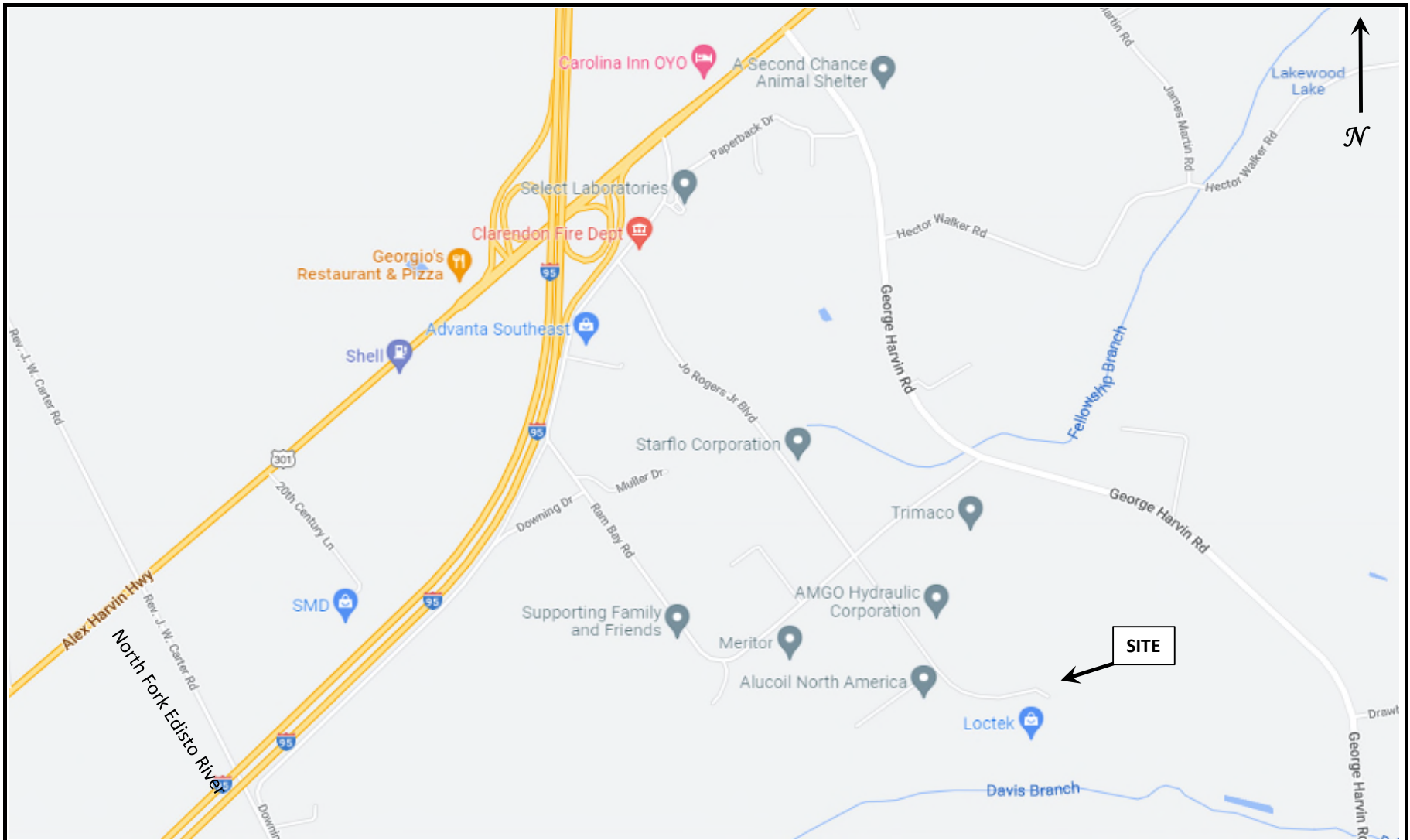
Our conclusions and recommendations are based on limited data from a field exploration program. Subsurface conditions can vary widely between explored areas. Some variations may not become evident until construction. If conditions are encountered which appear different than those described in our report, we should be notified. This report should not be construed to represent subsurface conditions for the entire site.

Unless specifically noted otherwise, our field exploration program did not include an assessment of regulatory compliance, environmental conditions or pollutants or presence of any biological materials (mold, fungi, bacteria). If there is a concern about these items, other studies should be performed. S&ME can provide a proposal and perform these services if requested.

S&ME should be retained to review the final plans and specifications to confirm that earthwork, foundation, and other recommendations are properly interpreted and implemented. The recommendations in this report are contingent on S&ME's review of final plans and specifications followed by our observation and monitoring of earthwork and foundation construction activities.

Appendices

Appendix I – Figures



SOURCE: Google Maps



SITE LOCATION PLAN		FIGURE NO.
JOB NAME:	Entrance Road to Clarendon County Industrial Park	
LOCATION:	Joe Rogers Jr Blvd	
CITY, STATE:	Manning, South Carolina	
JOB NO.:	218770	
SCALE:	NTS	CHECKED BY: RCB
DATE:	2/1/2023	DRAWN BY: KEF
		1



SOURCE: *Conceptual Site Plan*, produced by ACE, dated 6/26/2020



⊙ Approximate Boring Location

BORING LOCATION PLAN				FIGURE NO.
JOB NAME:	Entrance Road to Clarendon County Industrial Park			2
LOCATION:	Joe Rogers Jr Blvd			
CITY, STATE:	Manning, South Carolina			
JOB NO.:	218770			
SCALE:	NTS	CHECKED BY:	RCB	
DATE:	2/1/2023	DRAWN BY:	KEF	

Appendix II – Field Data

LEGEND TO SOIL CLASSIFICATION AND SYMBOLS




SOIL TYPES

(Shown in Graphic Log)

	Fill
	Asphalt
	Concrete
	Topsoil
	Gravel
	Sand
	Silt
	Clay
	Organic
	Silty Sand
	Clayey Sand
	Sandy Silt
	Clayey Silt
	Sandy Clay
	Silty Clay
	Partially Weathered Rock
	Cored Rock

WATER LEVELS

(Shown in Water Level Column)

-  = Water Level At Termination of Boring
-  = Water Level Taken After 24 Hours
-  = Loss of Drilling Water
- HC = Hole Cave

CONSISTENCY OF COHESIVE SOILS

CONSISTENCY

Very Soft	STD. PENETRATION RESISTANCE BLOWS/FOOT
Soft	0 to 2
Firm	3 to 4
Stiff	5 to 8
Very Stiff	9 to 15
Hard	16 to 30
Very Hard	31 to 50
	Over 50

RELATIVE DENSITY OF COHESIONLESS SOILS

RELATIVE DENSITY

Very Loose	STD. PENETRATION RESISTANCE BLOWS/FOOT
Loose	0 to 4
Medium Dense	5 to 10
Dense	11 to 30
Very Dense	31 to 50
	Over 50

SAMPLER TYPES

(Shown in Samples Column)

-  Shelby Tube
-  Split Spoon
-  Rock Core
-  No Recovery

TERMS

Standard Penetration Resistance - The Number of Blows of 140 lb. Hammer Falling 30 in. Required to Drive 1.4 in. I.D. Split Spoon Sampler 1 Foot. As Specified in ASTM D-1586.

REC - Total Length of Rock Recovered in the Core Barrel Divided by the Total Length of the Core Run Times 100%.

RQD - Total Length of Sound Rock Segments Recovered that are Longer Than or Equal to 4" (mechanical breaks excluded) Divided by the Total Length of the Core Run Times 100%.



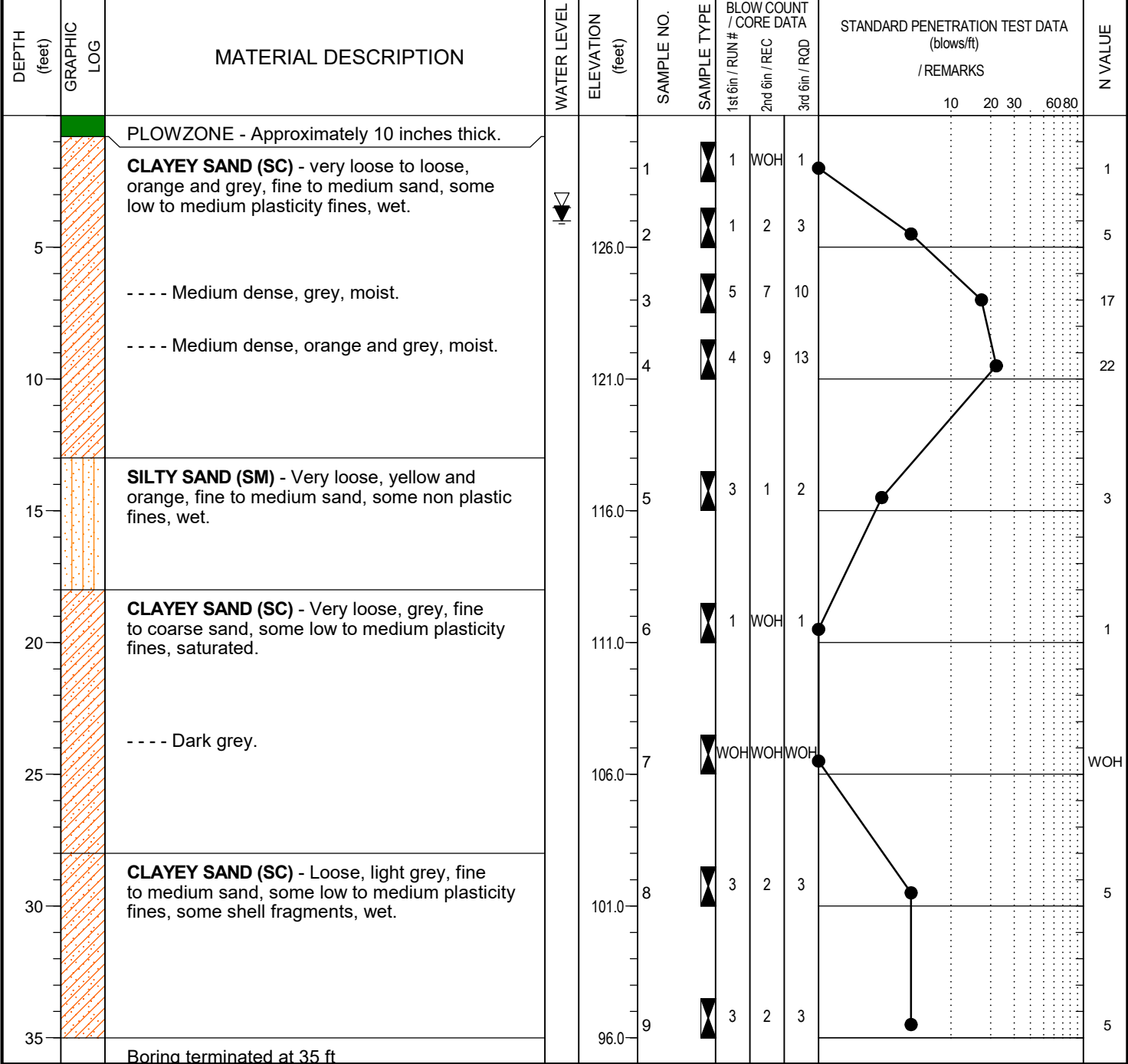
**New Entrance Road for Clarendon Industrial Park
Manning, South Carolina
S&ME Project No. 218770**

BORING LOG B-1

DATE DRILLED: 1/9/23	ELEVATION: 131.0 ft
DRILL RIG: CME 45-C	BORING DEPTH: 35.0 ft
DRILLER: W. Kannon	WATER LEVEL: 3.5' ATD, 4' 24 hr
HAMMER TYPE: Auto	LOGGED BY: W. Kannon
SAMPLING METHOD: Grab	

NOTES:

DRILLING METHOD: **Hand Auger**



S&ME BORING LOG \CLARENDON HAB LOGS.GPJ \ LIBRARY 2011_06_28.GDT \ 1/25/23

NOTES:

1. THIS LOG IS ONLY A PORTION OF A REPORT PREPARED FOR THE NAMED PROJECT AND MUST ONLY BE USED TOGETHER WITH THAT REPORT.
2. BORING, SAMPLING AND PENETRATION TEST DATA IN GENERAL ACCORDANCE WITH ASTM D-1586.
3. STRATIFICATION AND GROUNDWATER DEPTHS ARE NOT EXACT.
4. WATER LEVEL IS AT TIME OF EXPLORATION AND WILL VARY.





Report of Subsurface Exploration
Entrance Road to Clarendon County Industrial Park –
Roadway
Manning, Clarendon County, South Carolina
S&ME Project No. 218770

PREPARED FOR:

Alliance Consulting Engineers, Inc.
PO Box 8147
Columbia, South Carolina 29202

PREPARED BY:

S&ME, Inc.
134 Suber Road
Columbia, South Carolina 29210

February 1, 2023



February 1, 2023

Alliance Consulting Engineers, Inc.
PO Box 8147
Columbia, South Carolina 29202

Attention: Ms. Susan MacRae

Reference: **Report of Subsurface Exploration**
Entrance Road to Clarendon County Industrial Park – Roadway
Manning, Clarendon County, South Carolina
S&ME Project No. 218770

Dear Ms. MacRae:

As requested, S&ME, Inc. has completed field testing for the proposed pavements for the Clarendon County entrance roadway, in Clarendon County, South Carolina. Our work was performed in general accordance with our proposal, S&ME Proposal No 218770 Revision 3, dated November 28, 2022. This report includes the recommendations for the roadway portion of the project, the exploration of the pump station portion of this project is provided under separate cover.

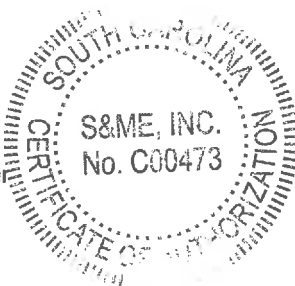
This report provides information on the exploration and testing procedures used, our boring records and our conclusions and recommendations regarding site conditions, site preparation, suitability of on-site soils for use as structural fill, fill placement and compaction, subgrade CBR value, and flexible asphalt pavement thickness for the proposed roadway improvements.

S&ME appreciates this opportunity to work with you as your geotechnical engineering consultant on this project. Please contact us at (803) 561-9024 if you have questions or need additional information regarding this report.

Sincerely,

S&ME, Inc.

Kara Fugate, E.I.T.
Associate Project Manager



Robert C. Bruorton, P.E.
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1.0 Project Information

Project information was initially provided by Susan MacRae (Alliance) to Chad Bruorton, P.E. (S&ME) in email correspondence on September 16, 2021. Ms. MacRae's correspondence included a Clarendon County GIS aerial photograph annotated with the anticipated roadway alignment. Further information was provided in email correspondence from Ms. MacRae to Mr. Bruorton on September 30, 2022, that included the *Conceptual Site Plan +/- 100,000-SF Speculative Building No. 9*, prepared by Alliance Consulting Engineers, dated September 27, 2022.

The project site is located at the eastern termination of the existing Joe Rogers Jr Boulevard, in Manning, Clarendon County, South Carolina, as shown on the *Site Location Plan*, attached as Figure 1 in Appendix I. We understand that the project consists of the construction of a roughly 1,300 linear foot roadway extension of Joe Rogers Jr Boulevard, across parcel 141-00-02-025-00, to expand the Clarendon County Industrial Park into parcel 141-00-02-056-00 to service the planned Speculative Building No. 9.

From our review of Google Earth mapping, existing grades across the site appear to slope from east to west and range from roughly elevation 137 to 133 feet.

Assumed traffic loading conditions were provided by Mr. Kyle Clampitt, P.E. of Alliance Consulting Engineers, during email correspondence on August 18, 2022, during pre-proposal discussions. As the planned development is speculative at this time, traffic loading conditions of 300 tractor-trailer trucks per day and 400 passenger vehicles per day, over a 20-year design life were provided.

2.0 Exploration Procedures

The subsurface exploration of this project included four (4) hand augered soil borings with Kessler (dual-mass) dynamic cone penetrometer (DCP) tests advanced to a depth of approximately 33 inches below the existing ground surface. Single mass DCP testing was conducted within the boreholes from a depth of approximately 3 feet to 5 feet in 1-foot increments. The approximate boring locations are shown on the *Boring Location Plan*, attached as Figure 2 in Appendix I.

2.1 Reconnaissance of Project Area

On November 29, 2022, representatives from S&ME visited the site to observe current site conditions, lay out proposed boring locations and conduct field tests. Soil test boring locations were laid out using our sub-meter GPS equipment. The boring locations and elevations indicated on the attached *Boring Location Plan* and boring logs must be considered as approximate. No formal survey of boring locations or elevations was conducted by S&ME.

2.2 Field Testing and Sampling

The following sections detail our field and sampling activities at the site.



2.2.1 *Kessler Dual-Mass Dynamic Cone Penetrometer (DCP) Testing*

Kessler (dual-mass) Dynamic Cone Penetrometer (DCP) testing was performed to a depth of approximately 33 inches below the existing ground surface at four (4) locations along the planned roadway alignment. The Kessler DCP testing was performed in general accordance with ASTM D6951. The DCP test involves driving a rod with a tip that is a 0.79-inch outside diameter, 60° cone into the ground using a 17.6-pound hammer, free-falling through a drop of 22.6 inches. The average depth (inch) driven by each hammer blow over each approximately 2-inch sampling interval is defined as the DCP Index. Softer/looser soils will yield a higher DCP Index than more stiff/dense soils. The DCP indices can be correlated to California Bearing Ratio (CBR) values based on extensive US Army Corps of Engineers research data. The CBR is a semi-empirical index based on the strength and deflection characteristic of soils, which can be used to predict pavement performance to establish pavement thickness design.

2.2.2 *Hand Augered Soil Borings*

After completion of the dual-mass DCP testing and in conjunction with the single mass DCP testing, S&ME performed four (4) hand augered soil borings (HA-1 through HA-4), one at each test location. Borings were performed to termination depths of roughly 5 feet below the existing ground surface. The soils encountered were identified in the field by cuttings brought to the surface. Representative samples of the cuttings were placed in sealed bags and later transported to the laboratory. Soils were field-classified by a geotechnical professional in general accordance with the visual-manual method described in ASTM D2488. Soil consistency was qualitatively estimated by the relative difficulty of advancing the augers.

2.2.3 *Single Mass Dynamic Cone Penetrometer (DCP) Testing*

Once the Kessler DCP test was finished, as the hand auger borings were advanced, the augers were withdrawn and soil consistency was measured with a dynamic cone penetrometer at 1-foot intervals. The conical point of the penetrometer was first seated 1-3/4 inches to penetrate any loose cuttings in the boring, then driven two additional 1-3/4 inch increments by a 15 pound hammer falling 20 inches. The number of hammer blows required to achieve this penetration was recorded. When properly evaluated by qualified professional staff, the blow count is an index to the soil strength.

2.2.4 *Ground Water Measurements*

Measurement of ground water was attempted to be measured within the borings at the time of drilling. Water was only encountered within hand auger boring HA-4 at a depth of roughly 4½ feet below the existing ground surface. The boreholes were backfilled prior to leaving the site due to safety concerns, and stabilized ground water measurements were not obtained.

2.2.5 *Borehole Closure*

Following collection of relevant geotechnical data, boreholes were filled by slowly pouring auger cuttings into the open hole such that minimal "bridging" of the material occurred in the hole. Backfilling of the upper two feet of each hole was tamped as heavily as possible with a shovel handle or other hand-held equipment, and the backfill crowned to direct rainfall away on the surface.



3.0 Site Conditions

S&ME's assessment of the geotechnical conditions began with a reconnaissance of the topography and physical features of the site. We also consulted various available topographic and geologic maps for relevant information.

3.1 Surface Conditions

As previously mentioned, the project consists of the construction of a roughly 1,300 linear foot roadway extension of Joe Rogers Jr Boulevard, across parcel 141-00-02-025-00, to expand the Clarendon County Industrial Park into parcel 141-00-02-056-00 to service the planned Speculative Building No. 9. Surface water was not observed at the time of our exploration. An existing ditch was observed near the end of the planned alignment with standing water measuring a few inches deep, beginning approximately 4 feet below the adjacent, existing ground surface.

3.2 Subsurface Conditions

Recovered field samples and field boring logs were reviewed by a member of our geotechnical staff. Soil test boring records are attached.

3.2.1 *Site Geology*

Manning, South Carolina lies immediately southeast of a topographical feature termed the Citronelle Escarpment. The escarpment denotes the boundary between the upper and middle portions of the Atlantic Coastal Plain of South Carolina and is a major topographical feature of the Coastal Plain. The area northwest of the escarpment is termed the Santee Hills and is underlain by Tertiary age Coastal Plain soils. Areas southeast of the escarpment, lie within the Atlantic Flatwoods Region of the Lower Coastal Plain of South Carolina.

The Atlantic Flatwoods comprises most of the Lower Coastal Plain, extending to the Surry Escarpment 15 to 40 miles inland from the sea. The topography of this region is dominated by up to six archaic marine terraces, exposed above sea level by uplifting of the local area over the last one million years. The terraces exhibit minor surface erosion but can be traced large distances on the basis of surface elevation. Abandoned tidal eddies on the terraces have been filled with sediments and now form shallow, poorly drained elliptical depressions on the surface, termed Carolina Bays, which are commonly apparent on aerial photographs or local topographic maps. Materials comprising the terraces typically consist of a strand or beach ridge deposit of clean sands at the seaward margin, interbedded with progressively more fine grained soils to the west. The marine terraces form a thin veneer over older, underlying Coastal Plain marl.

3.2.2 *USDA Soil Survey Information*

From a qualitative standpoint, the USDA Natural Resources Conservation Service's Soil Surveys can often provide helpful information. The surveys map the near surface soils (i.e., depths \leq 6 ft.) and provide general descriptions. The data is not intended to replace geotechnical evaluations and testing, but it can help identify trends. Soil maps are often a useful indication of the geologic environment governing soil behavior as well as the seasonal depth to ground water and depth to rock.



The USDA-NCSS web-based SoilWeb and USDA Natural Resource Conservation Service soils map of Clarendon County, South Carolina, issued in 1988 were reviewed. Two (2) series were indicated within the project area:

- Dothan loamy fine sand (DoA) – nearly level to gently sloping, deep, well drained soils formed of loamy Coastal Plain sediments on broad ridges throughout the county.
- Lynchburg loamy sand (Ly) – nearly level, deep, somewhat poorly drained soils formed in loamy Coastal Plain sediment in broad areas.

Table 3-1 – USDA Soil Series Survey

Soil Series	Soil Type	Depth to Seasonal High GW Table	Permeability	Shrink / Swell Potential	Soil Reaction
DoA	SC, CL, SM, SC-SM	Greater than 6 feet	Moderate to Moderately Rapid	Low	Very Strongly to Medium acid
Ly	SM, SC, CL	1 to 2 feet	Moderate to Moderately Rapid	Low	Very Strongly to Medium acid

The USDA information provided for this site points to a few items that could influence geotechnical recommendations for the planned pavements.

- Soil series Ly is noted to have a shallow seasonal high ground water table.
- Soil series across the site are noted to have a very strong to medium acidic soil reaction.

The USDA Soil Survey for the site is shown on the *USDA Soil Survey Map*, attached as Figure 3 in Appendix I.

3.2.3 *Interpreted Subsurface Profile*

The generalized subsurface conditions at the site are described below. The discussed subsurface description is of a generalized nature to highlight the major subsurface stratification features and material characteristics. The boring records included in Appendix II should be reviewed for specific information at each boring location. The depth and thickness of the subsurface strata indicated on the boring records was estimated based on the auger cuttings and the samples recovered. The transition between materials may be more gradual than indicated on the boring records. Information on actual subsurface conditions exists only at the specific boring locations and is relevant to the time the exploration was performed. Variations may occur and should be expected at locations remote from the boring. The stratification lines were used for our analytical purposes and, unless specifically stated otherwise, should not be used as the basis for design or construction cost estimates. Soil test boring records are attached in Appendix II.



Surface Materials - "Plow Zone" Soils

At the existing ground surface, the hand auger borings encountered an agricultural "plow zone". The "plow zone" ranged in thickness from roughly 9 inches to 11 inches. "Plow Zone" soils are typically encountered in areas used for agricultural purposes and influenced by cycles of discing and growing of crops. "Plow zone" soils were typically dark brown or gray and contain varying amounts of organics.

Coastal Plain Deposits

Beneath the "Plow Zone" soils, native Coastal Plain deposits were encountered in our borings, extending to the termination depth of 5 feet below the existing ground surface. The native deposits consisted of fine to medium sands with few to some low to medium plasticity fines (SC, SP-SC or SM). Recovered samples were generally white, tan, shades of brown, orange, red and gray in color and were moist to wet to the touch.

Ground Water

Ground water was only encountered within one of the hand auger borings advanced on-site at a depth of roughly 4½ feet below the existing ground surface. As previously mentioned, boreholes were backfilled with auger cuttings prior to leaving the site. However, the USDA Soil Survey indicates shallow seasonal high ground water within this portion of the site, and this measured ground water level roughly coincides with the observed standing water within the nearby adjacent ditch. Therefore, dependent on the planned grades across the site, it appears that ground water may impact construction on this site.

It is important to note that ground water levels are influenced by precipitation, long term climatic variations, and nearby construction. Also, ground water levels may differ in unexplored areas across the site. Measurements of ground water made at different times than our exploration may indicate ground water levels substantially different than indicated on the boring records in Appendix II.

4.0 Conclusions and Recommendations

The following paragraphs include our conclusions and recommendations regarding site preparation, suitability of on-site soils for use as structural fill, fill placement and compaction, subgrade CBR value, and flexible asphalt pavement thickness for the proposed roadway.

The soil profile encountered at this site appears suitable for the proposed development. Conditions at this site do not appear to pose issues for site preparation or grading that differ substantially from the surrounding region.

4.1 Site Preparation

Site preparation should include removal of unsuitable surface materials within the proposed pavement areas. This should include surface debris, surface vegetation and organic laden topsoil, stumps, root bulbs, as well as unstable surface or subsurface soils. As previously mentioned, up to roughly 11 inches of "Plow Zone" was encountered across the site. Topsoil and organic matter may be thicker in areas not explored at this time.

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The organic content of the “Plow Zone” materials encountered at the existing ground surface was not tested, therefore, the depth of initial stripping is not known at this time, and could vary, depending on the actual organic content of the soils and the project specifications. If these soils are to remain in-place or are to be re-used as structural fill, the organic content should be tested, in general accordance with ASTM D2974.

4.1.1 *Proofrolling and Stabilization*

After removal of topsoil and unsuitable soils/materials and cutting to grade, but prior to fill placement where required, the exposed ground surface should be observed by the geotechnical engineer or a representative of the geotechnical engineer to confirm that poor soils have been removed and that the exposed subgrade is suitable for support of pavements.

To aid in evaluation of the exposed soils, the area should be proofrolled using a loaded dump truck or similarly loaded piece of equipment. Areas that rut, pump, or move excessively under movement of the equipment should be stabilized prior to placement of fill soil. If left in place, soft or wet soils will exhibit substantially lower bearing for pavements. Stabilization, if required, may consist of removing and replacing unstable material or, where unstable soils are thin, wetting/drying and compacting in-place.

Care should be taken during construction so that the subgrade soils are not disturbed more than necessary. If heavily reworked or disturbed, stabilization may be required for what could otherwise be considered an acceptable subgrade.

4.1.2 *Surface Preparation/In-place Densification*

From the results of our near-surface DCP testing, it appears that the upper sandy soils are very loose to loose in nature along the majority of the alignment. Therefore, depending on planned grades, we recommend that these upper soils be densified in-place using a moderate weight (6 to 8-ton static weight) vibratory roller.

We recommend that at least 3 passes be made. Field results can vary and are highly dependent on the roller selected, the in-situ moisture content of the soils, and the ability to achieve confinement along at least one side of the area being densified. It should be expected that the in-place densification activities will lower the existing ground surface within the areas of densification, since the underlying sandy soils are becoming compacted, therefore, fill soils may be required to bring the densified area to grade after the process is complete.

In-place densification activities should be verified as the work is in progress. Densification at the surface can be evaluated using field density tests (nuclear density gauge or sand cone). We recommend that the density achieved at depth be evaluated by performing hand augered soil borings with single-mass dynamic cone penetrometer (DCP) testing at several representative locations. The frequency and depth of these verification borings and testing will be dictated by the size and depth of the area being densified in-place. As a general guide, in-place densification should achieve a DCP blow count value of roughly 8 blows per increment (bpi).

4.1.3 *Dewatering Considerations*

Although planned grades were unavailable at the time of this report, the data suggests that shallow ground water may be encountered during grading activities. A temporary system that has performed adequately on previous



projects with similar conditions consists of temporary excavations (ditches) and sump pumps. Pumping from the sumps should be maintained until fill placement is a minimum of three feet above the water level. Other means of improving drainage at the site may be accomplished with ditches located at select areas.

Continue dewatering during fill placement to maintain groundwater at its lowered elevation. If discontinued prematurely, the ground water level will rise, saturating the fill soils and preventing effective compaction. When the area has been filled more than three feet above the natural groundwater level, dewatering may be discontinued.

If ground water or infiltrating surface water is not properly controlled during construction, the subgrade soils which will support foundations as well as floor slabs, may be damaged. Furthermore, construction equipment mobility may be impaired.

4.2 Use of On-site Soils as Structural Fill

The on-site soils that may be proposed for use as fill at the site generally exhibited a USCS soil classification of sands with varying amounts of fines (SC).

Coarse grained soils, similar to those encountered at the site, are typically suitable for use as structural fill and for use as the immediate subgrade for pavements. Before beginning to place fill, sample and test each proposed fill material to determine maximum dry density, optimum moisture content, natural moisture content, gradation and plasticity of the soil.

Although suitable for use as structural fill, it is important to note that clayey sandy (SC) soils can be moisture sensitive to some degree due to their higher plasticity fines content, and therefore, can be difficult to work if allowed to become wet. These difficulties can include softening of exposed subgrade soils, excessive rutting or deflection under construction traffic, and the difficulty associated with adequately drying and compacting wet soil. Moisture-related earthwork difficulties can be reduced by performing the earthwork during the typically drier months of the year (May through October).

4.3 Fill Placement and Compaction

Structural soil fill material should have less than 5 percent organic matter, a standard Proctor maximum dry density of 90 pcf or greater and a plasticity index (PI) of 30 percent or less. We recommend that off-site borrow meet the organic content, PI and density requirements of this section. Testing will be required before fill placement begins to determine the optimum moisture-density condition for the fill materials. Material to be used as soil fill should be tested and approved by the geotechnical engineer before being placed.

4.3.1 Density and Moisture Requirements

Place fill, where required, in maximum 8-inch loose lifts and compact to at least 98 percent of maximum dry density (ASTM D698 standard Proctor). Fill moisture content should be maintained within +/- 3 percent of the optimum moisture content. Contractor should be prepared to wet or dry soils as necessary to achieve compaction. Fill should be placed level at least 5 feet beyond the pavement footprint before sloping. In addition



to meeting the compaction requirement, fill material must be stable under movement of the construction equipment and must not exhibit rutting or pumping after compacting.

4.3.2 Compaction of Granular Soils

A vibratory sheeps-foot roller will likely be more effective for compaction of clayey sandy (SC) soils. Sheeps-foot compactors will likely be preferable because the pads better penetrate the soil and tend to break down the natural cohesive bonds between the particles.

Sandy soils excavated above the water table are usually close enough to optimum moisture content to place and compact efficiently with little moisture conditioning required. Soils that are initially too wet or are allowed to become wet due to rainfall are more difficult to use.

4.3.3 Monitoring and Testing

Fill placement, where required, should be witnessed by an experienced soils technician working under the guidance of the geotechnical engineer. We recommend full time observation by a qualified soils technician with testing at random intervals to confirm compaction is being achieved. Part-time testing may suffice for utility trench fills.

4.4 Pavement Support and Construction

Pavement sections at the site are assumed to consist of flexible asphalt pavement.

4.4.1 Subgrade Support Value

The estimated field CBR values from our Kessler DCP testing ranged from 3.7 to 5.6 percent, with an average of 4 percent, within the upper roughly 30 inches of the existing ground surface at the areas tested. Assuming that the near surface densification recommendations are followed as listed in this report, we have assumed a CBR of at least 6 percent will be available for pavement support. This equated to a resilient modulus (MR) of 8,040 psi. This also assumes that fill material placed within the proposed pavement areas is placed and compacted according to the recommendations given in this report. Imported fill, if required, should be tested to determine that it exhibits a CBR equivalent to or exceeds the value assumed in pavement recommendations.

We recommend that special care be given to providing adequate drainage away from pavement areas to reduce infiltration of surface water to the base course and subgrade materials in these areas. Water should be detoured away from the pavement areas and adequate slopes provided to maintain drainage off site. Pavement areas should be proofrolled prior to placing structural fill and/or aggregate base course. Proofrolling procedures are outlined in other sections of this report.

4.4.2 Traffic Volumes

It is understood that the roadway improvements are related to expansion of the existing industrial park. As previously discussed, we understand that the estimated traffic volume conditions are 300 tractor-trailer trucks per day and 400 passenger vehicles per day, over a 20-year design life. Standard design nomographs for flexible



pavements are based on life cycle wheel load repetitions for a mix of both automobiles and light and heavy trucks, reduced to an 18-kip single axle equivalent load.

4.4.3 Flexible Asphalt Pavements

Pavement thickness computations were performed using the SCDOT *Pavement Design Guidelines – 2008* and AASHTO '93 *Flexible Pavement Design Method* for analysis of the unreinforced flexible pavement section. Based on the subsurface conditions encountered and assuming our grading recommendations will be implemented as specified, the following presents our recommendations regarding typical pavement sections and materials. Using the above-described assumed traffic loadings, we recommend the minimum pavement section indicated in the table below.

Table 4-1 – Recommended Flexible Pavement Section Thickness

Pavement Designation	Cement Modified Subbase	Graded Aggregate Base Course	Asphalt Intermediate Course	Asphalt Surface Course
5,200,000 ESAL Asphalt Roadway	6 inches	8 inches	3¼ inches	1½ inches

It is our opinion that the flexible pavement should consist of a wearing course of hot mix asphaltic (HMA) concrete, an intermediate course of HMA concrete and a base course of graded aggregate Macadam Base Course material on cement modified subbase materials. Base course material is necessary for structural support.

Materials and workmanship should meet the minimum requirements of the SCDOT *Standard Specifications for Highway Construction*, 2007 Edition and supplemental specifications. The applicable sections include the following:

Table 4-2 – SCDOT Bituminous Pavements Specifications

Section	2007 SCDOT Standard Specification Section
Subgrade	Section 208, page 130
Cement Modified Sub-Base	Section 301, page 140
Graded Aggregate Base Course	Section 305, page 159
Hot Mixed Asphalt Pavement	Section 401, page 188
Hot Mix Asphalt Surface Course	Section 403, page 220
Supplemental Specifications	
HMA Material Properties, dated July 1, 2006	
HMA Courses, dated Jul 2, 2006	

Sufficient testing should be performed during flexible pavement installation to confirm that the required thickness, density, and quality requirements of the pavement specifications are followed. This is very important



for the long-term performance of the pavement, and can be performed by S&ME, Inc. as part of our construction materials testing services.

4.4.4 Base Course Materials

As provided, the subbase materials recommended for the pavements should consist of graded aggregate base course over cement modified subbase materials. Therefore, we provide the following recommendations for both materials.

Soil-Cement Subbase Course

Base course materials assumed in computation of pavement sections above consists of materials meeting the requirements of cement modified subbase defined in current SCDOT Standard Specifications (2007 ed.) Section 301. Laboratory soil cement mix design testing must be performed to determine the required cement application rate.

The quality of a soil-cement subbase course depends greatly on the mixing and compacting procedures. Most failures in soil-cement applications have been due to improper mixing where unstabilized soil lumps are found surrounded by an over-cemented soil matrix. It is difficult to achieve as adequate a mixing in the field as in the laboratory. However, by following accepted procedures, an experienced contractor can closely match the homogeneity of the laboratory mix.

Sandy soils can generally break apart easily and are readily mixed with the cement using disc plows or other simple equipment. More clayey soils resist manipulation by simple equipment and generally require mechanical mixers that cut or pulverize the lumps at relatively high speed. Based on soil types observed at the site, we expect the former type will be more appropriate here.

We estimated an average cement requirement based on visual-manual manipulation of the recovered soils and classification tests of representative samples in the laboratory. For a typical sandy soil with few to some fines content, we estimate soils will require 4 to 6 percent cement based on dry soil weight. However, the percentage cement required should be based on trial mixes prepared in the laboratory prior to construction.

Water added to the mixture should be carefully gauged to adjust moisture content slightly below or equal to the optimum moisture content during compaction. Too much water will result in loss of compressive strength of the soil-cement mixture due to washing out of the cement. Too much water also inhibits the breakdown of the more clayey materials and prevents adequate mixing of the soil-cement. Too little water will prevent adequate hydration.

We recommend soil-cement construction be accomplished in the following manner:

1. Grade and compact the soil to the required subgrade elevation.
2. Place the soil to be used in the soil-cement mix in wind-rows, providing sufficient material for a compacted thickness of about 6 inches per lift.
3. Place the required volume of cement on top of the wind-rows. No cement should be applied unless the temperature is at least 40 degrees F and rising.

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4. Mix the soil and cement and distribute evenly over the area to be paved, including a 2-foot wide extension around the perimeter of the paved area. Mixing should extend the full depth of the lift.
5. Test the moisture content of the mix. Add the water needed to bring the moisture up to optimum moisture content. One or two percent more water should be added to allow for evaporation. Water shall be thoroughly mixed with the soil.
6. Compact the mixture to at least 98 percent of the Standard Proctor compaction maximum density. The soil-cement mix can be compacted with the same equipment used to compact the soil alone.
7. Soil-cement compaction should begin no later than thirty minutes following moistening. A minimum of one field density test should be performed for every 5,000 sq. ft. of application per lift to confirm that the recommended density is achieved.
8. Repeat the above procedure for additional lifts if necessary. Additional soil-cement lifts should be constructed immediately following compaction of preceding lift(s) so that shear planes do not form between the layers.
9. After compaction, the completed surface may require trimming or fine grading to the required slopes. Contractor should only work as large an area that can be completed during daylight hours.

It is important that effective curing of the soil-cement mix occur to obtain the design strength. At least seven days moist curing is necessary to allow the soil-cement to gain the required strength and rigidity. A bituminous prime coat should be sprayed on immediately to retain the existing moisture. Waterproof membranes, wet cloths, or wet straw can also be used for this purpose. Where necessary for temporary roadways to cross the curing area, designated areas should be covered with at least 8 inches of soil to protect the completed base.

Soil-cement subbase construction should be witnessed by the geotechnical engineer. Frequent measurements of the thickness of the soil-cement base should be made to verify the contractor's procedures produce an adequate coverage. In addition, we recommend that unconfined compressive strength tests be performed on a minimum of 1 cored sample of the stabilized mix per 5,000 square feet of application after the 7-day curing cycle is complete. Samples should have a minimum compressive strength of 600 psi.

Graded Aggregate Base Course

Base course materials assumed in computation of pavement sections above consists of materials meeting the hardness, durability and gradation requirements of graded aggregate base course (GABC) defined in current SCDOT *Standard Specifications* (2007 ed.) section 305. The crushed stone graded aggregate base course (GABC) used in pavement section construction should meet the requirements of Section 305 of the SCDOT *Standard Specifications* (2007 ed.) and should consist of "Macadam Base Course" as defined by Section 305.02 of the SCDOT specification.

Fill placed in pavement areas should be compacted as recommended in preceding sections. Prior to pavement installation, all exposed pavement subgrades should be methodically proofrolled at final subgrade elevation under the observation of the S&ME, Inc. geotechnical engineer, and any identified unstable areas should be repaired as directed.

As stated in the SCDOT Section 305, base course should be compacted to at least 100 percent of the modified Proctor maximum dry density (ASTM D1557) and should not exhibit pumping or rutting under equipment traffic.



Heavy compaction equipment is likely to be required in order to achieve the required base course compaction, and the moisture content of the material will likely need to be maintained very near the optimum moisture content in order to facilitate proper compaction. Base course of greater than 8 inches total thickness must be constructed in two lifts of approximately equal thickness. S&ME, Inc. should be contacted to perform field density and thickness testing of the base course prior to paving.

4.4.5 *General*

Pavement performance is very dependent on subgrade condition. Drainage will have a major impact on subgrade condition. Drainage should be designed to result in subsurface water levels being at least 2 feet below the top of the pavement subgrade. Design should not result in water standing on the pavement surface or behind curbing. Landscaped areas behind curbing should be at or above the elevation of the curbing. Design should result in positive drainage being available from the stone base material.

The performance of the pavement will be influenced by a number of factors including the actual condition of subgrade soils at the time of pavement installation, installed thicknesses and compaction, and drainage. The subgrade soils should be re-evaluated by proofrolling immediately prior to placement of base course stone and unstable areas repaired. This recommendation is very important to the long-term performance of the pavements. Areas adjacent to pavements (embankments, landscaped island, ditching, etc.) which can drain water (rainwater or sprinklers) should be designed so that water does not seep below the pavements. This may require the use of French drains or swales. Sufficient tests and inspections should be performed during pavement installation to confirm that the required thickness, density, and quality requirements of the specifications are followed.

Experience indicates that a thin surface overlay of asphalt pavement may be required in about 10 years due to normal wear and weathering of the surface. Such wear is typically visible in several forms of pavement distress, such as aggregate exposure and polishing, aggregate stripping, asphalt bleeding and various types of cracking. There are means to methodically estimate the remaining pavement life based on a systematic statistical evaluation of pavement distress density and mode of failure. We recommend the pavement be evaluated in about 7 years to assess the pavement condition and remaining life.

5.0 **Qualifications of Report**

This report has been prepared in accordance with generally accepted geotechnical engineering practice for specific application to this project. The conclusions and recommendations contained in this report are based upon applicable standards of our practice in this geographic area at the time this report was prepared. No other representation or warranty either express or implied, is made.

We relied on project information given to us to develop our conclusions and recommendations. If project information described in this report is not accurate, or if it changes during project development, we should be notified of the changes so that we can modify our recommendations based on this additional information if necessary.

Our conclusions and recommendations are based on limited data from a field exploration program. Subsurface conditions can vary widely between explored areas. Some variations may not become evident until construction.



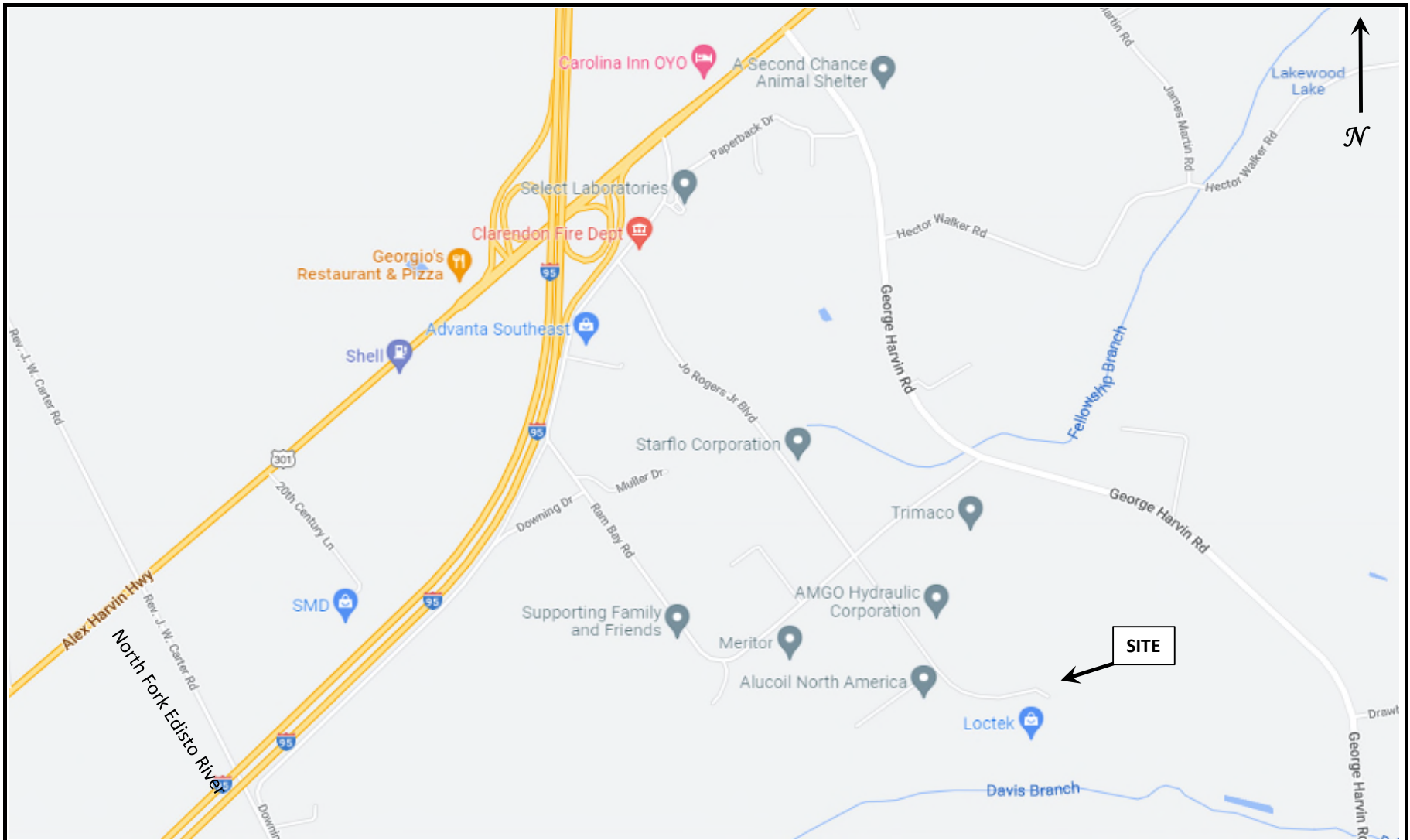
If conditions are encountered which appear different than those described in our report, we should be notified. This report should not be construed to represent subsurface conditions for the entire site.

Unless specifically noted otherwise, our field exploration program did not include an assessment of regulatory compliance, environmental conditions or pollutants or presence of any biological materials (mold, fungi, and bacteria). If there is a concern about these items, other studies should be performed. S&ME can provide a proposal and perform these services if requested.

S&ME should be retained to review the final plans and specifications to confirm that earthwork, foundation, and other recommendations are properly interpreted and implemented. The recommendations in this report are contingent on S&ME's review of final plans and specifications followed by our observation and monitoring of earthwork and foundation construction activities.

Appendices

Appendix I – Figures



SOURCE: Google Maps



SITE LOCATION PLAN		FIGURE NO.
JOB NAME:	Entrance Road to Clarendon County Industrial Park	
LOCATION:	Joe Rogers Jr Blvd	
CITY, STATE:	Manning, South Carolina	
JOB NO.:	218770	
SCALE:	NTS	CHECKED BY: RCB
DATE:	2/1/2023	DRAWN BY: KEF
		1



SOURCE: *Conceptual Site Plan*, produced by ACE, dated 6/26/2020



⊙ Approximate Boring Location

BORING LOCATION PLAN

JOB NAME: Entrance Road to Clarendon County Industrial Park
LOCATION: Joe Rogers Jr Blvd
CITY, STATE: Manning, South Carolina
JOB NO.: 218770

FIGURE NO.

2

SCALE:	NTS	CHECKED BY:	RCB
DATE:	2/1/2023	DRAWN BY:	KEF



SOURCE: USDA Soil Survey



USDA SOIL SURVEY MAP

JOB NAME: Entrance Road to Clarendon County Industrial Park
LOCATION: Joe Rogers Jr Blvd
CITY, STATE: Manning, South Carolina
JOB NO.: 218770

FIGURE NO.

3

SCALE: NTS

CHECKED BY: RCB

DATE: 2/1/2023

DRAWN BY: KEF

Appendix II – Field Data

LEGEND TO SOIL CLASSIFICATION AND SYMBOLS




SOIL TYPES

(Shown in Graphic Log)

	Fill
	Asphalt
	Concrete
	Topsoil
	Gravel
	Sand
	Silt
	Clay
	Organic
	Silty Sand
	Clayey Sand
	Sandy Silt
	Clayey Silt
	Sandy Clay
	Silty Clay
	Partially Weathered Rock
	Cored Rock

WATER LEVELS

(Shown in Water Level Column)

-  = Water Level At Termination of Boring
-  = Water Level Taken After 24 Hours
-  = Loss of Drilling Water
- HC = Hole Cave

CONSISTENCY OF COHESIVE SOILS

<u>CONSISTENCY</u>	<u>STD. PENETRATION RESISTANCE BLOWS/FOOT</u>
Very Soft	0 to 2
Soft	3 to 4
Firm	5 to 8
Stiff	9 to 15
Very Stiff	16 to 30
Hard	31 to 50
Very Hard	Over 50

RELATIVE DENSITY OF COHESIONLESS SOILS

<u>RELATIVE DENSITY</u>	<u>STD. PENETRATION RESISTANCE BLOWS/FOOT</u>
Very Loose	0 to 4
Loose	5 to 10
Medium Dense	11 to 30
Dense	31 to 50
Very Dense	Over 50

SAMPLER TYPES

(Shown in Samples Column)

-  Shelby Tube
-  Split Spoon
-  Rock Core
-  No Recovery

TERMS

Standard Penetration Resistance - The Number of Blows of 140 lb. Hammer Falling 30 in. Required to Drive 1.4 in. I.D. Split Spoon Sampler 1 Foot. As Specified in ASTM D-1586.

REC - Total Length of Rock Recovered in the Core Barrel Divided by the Total Length of the Core Run Times 100%.

RQD - Total Length of Sound Rock Segments Recovered that are Longer Than or Equal to 4" (mechanical breaks excluded) Divided by the Total Length of the Core Run Times 100%.



PROJECT: New Entrance Road for Clarendon Industrial Park Manning, South Carolina 218770		HAND AUGER BORING LOG: HA-1				
DATE STARTED: 11/29/22		DATE FINISHED: 11/29/22		NOTES:		
SAMPLING METHOD: Hand Auger		PERFORMED BY: W. Kannon				
WATER LEVEL: Not encountered						
Depth (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (feet)	WATER LEVEL	DYNAMIC CONE PENETRATION RESISTANCE (blows/1.75 in.)	DCP VALUE
					10 20 30 60 80	
		PLOWZONE - 9 inches				
1		CLAYEY SAND (SC) - Yellowish brown and orange, mostly fine to medium sand, some low to medium plasticity fines, moist.	135.00			
2			134.00			
3		--- Very loose, orange and tan, wet.	133.00			4
4		--- Loose, orange and gray, wet to moist.	132.00			7
5		Boring terminated at 5 ft	131.00			10



DCP INDEX IS THE DEPTH (IN.) OF PENETRATION PER BLOW OF A 10.1 LB HAMMER FALLING 22.6 IN., DRIVING A 0.79 IN. O.D. 60 DEGREE CONE.

Kessler DCP Test Results

ASTM D6951/ACOE GL-92-3/ACOE GL-94-17



Project: New Entrance Roadway for Clarendon Industrial Park Date: 11/29/2022
 Project Number: 218770 Personnel: WDK
 Test Location: HA-1

Soil Type

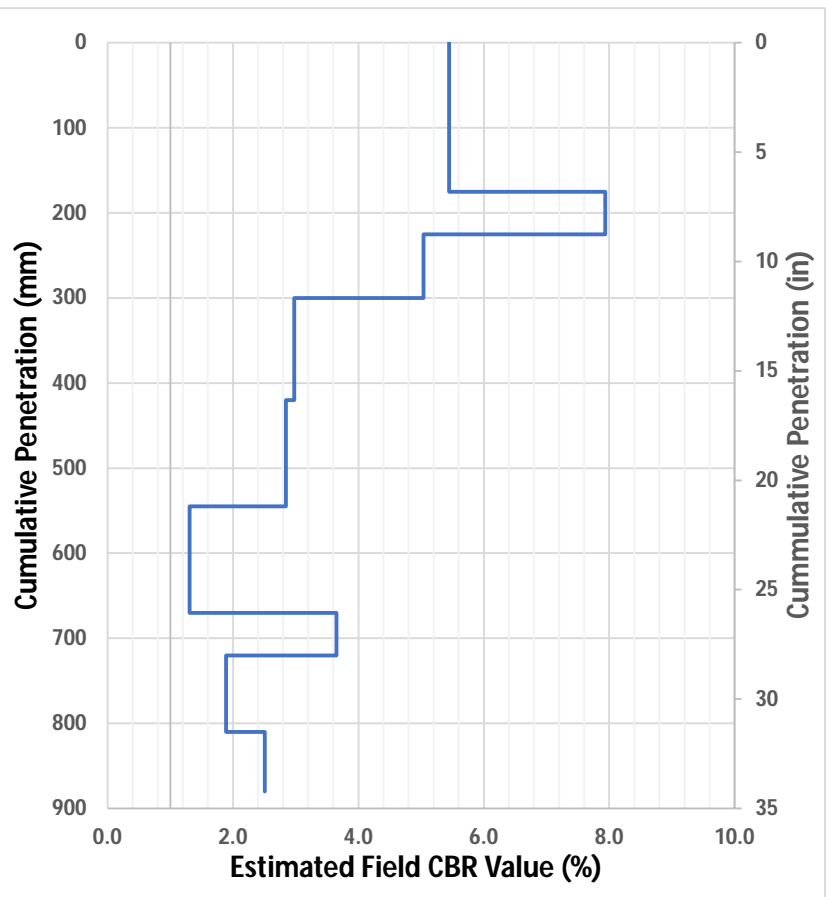
All Other Soils
 CH
 CL (estimated CBR <10)

Hammer Type

Dual 17.6 lb
 Single 10.1 lb

Test Data			
Number of Blows	Cumulative Penetration		Hammer Type
	(mm)	(in)	
5	0		1
5	175		1
2	225		1
2	300		1
2	420		1
2	545		1
1	670		1
1	720		1
1	810		1
1	880		1

Subgrade	
No. of Values:	9
Average CBR:	3.7
Max CBR:	7.9
Min CBR:	1.3



References:

- 1) ASTM D6951 *Standard Test Method for Use of Dynamic Cone Penetrometer in Shallow Pavement Applications*
- 2) ACOE Instruction Report GL-92-3 *Description and Application of Dual Mass Dynamic Cone Penetrometer*
- 3) ACOE Technical Report GL-94-17 *Force Protection Site Evaluation Using the Electronic Cone Penetrometer (ECP) and the Dynamic Cone Penetrometer (DCP)*

PROJECT: New Entrance Road for Clarendon Industrial Park Manning, South Carolina 218770				HAND AUGER BORING LOG: HA-2						
DATE STARTED: 11/29/22		DATE FINISHED: 11/29/22		NOTES:						
SAMPLING METHOD: Hand Auger		PERFORMED BY: W. Kannon								
WATER LEVEL: Not encountered										
Depth (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (feet)	WATER LEVEL	DYNAMIC CONE PENETRATION RESISTANCE (blows/1.75 in.)					DCP VALUE
					10	20	30	60	80	
		PLOWZONE - 10 inches								
1		CLAYEY SAND (SC) - Yellowish brown and orange, mostly fine to medium sand, some low to medium plasticity fines, moist.	134.00							
2			133.00							
3		--- Loose, orange, red, and gray, moist.	132.00							8
4		--- Medium dense, orange and gray, moist.	131.00							10
5		Boring terminated at 5 ft	130.00							11



DCP INDEX IS THE DEPTH (IN.) OF PENETRATION PER BLOW OF A 10.1 LB HAMMER FALLING 22.6 IN., DRIVING A 0.79 IN. O.D. 60 DEGREE CONE.

Kessler DCP Test Results

ASTM D6951/ACOE GL-92-3/ACOE GL-94-17



Project: New Entrance Roadway for Clarendon Industrial Park Date: 11/29/2022
 Project Number: 218770 Personnel: WDK
 Test Location: HA-2

Soil Type

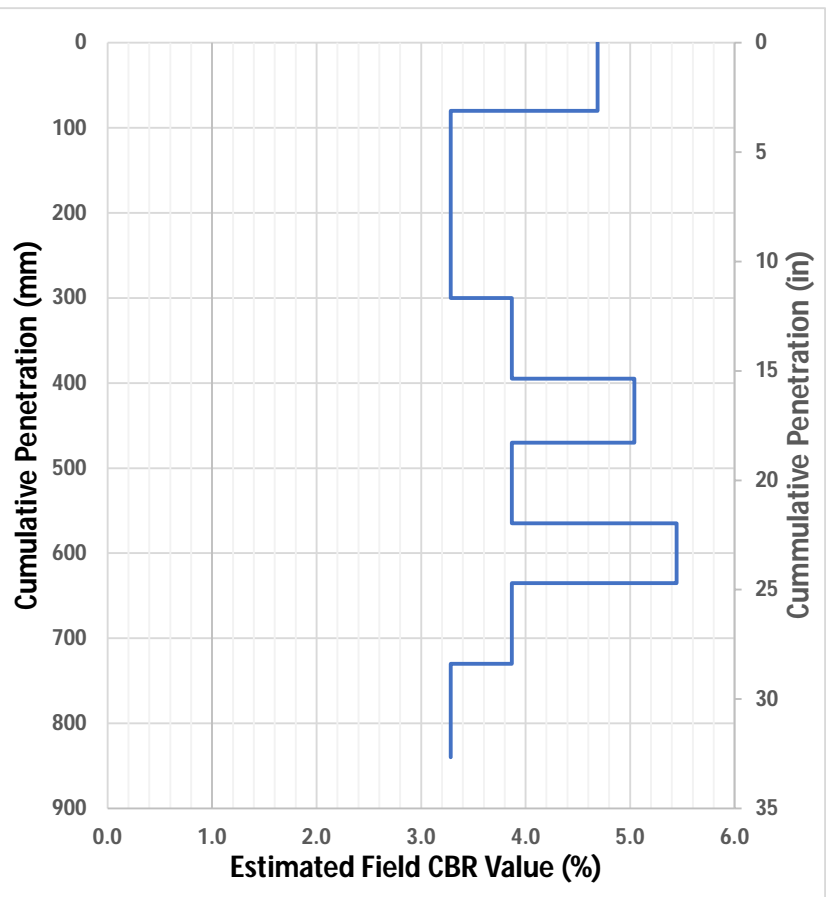
All Other Soils
 CH
 CL (estimated CBR <10)

Hammer Type

Dual 17.6 lb
 Single 10.1 lb

Test Data			
Number of Blows	Cumulative Penetration		Hammer Type
	(mm)	(in)	
0	0		1
2	80		1
2	190		1
2	300		1
2	395		1
2	470		1
2	565		1
2	635		1
2	730		1
1	785		1
1	840		1

Subgrade	
No. of Values:	10
Average CBR:	4.0
Max CBR:	5.4
Min CBR:	3.3



References:

- 1) ASTM D6951 *Standard Test Method for Use of Dynamic Cone Penetrometer in Shallow Pavement Applications*
- 2) ACOE Instruction Report GL-92-3 *Description and Application of Dual Mass Dynamic Cone Penetrometer*
- 3) ACOE Technical Report GL-94-17 *Force Protection Site Evaluation Using the Electronic Cone Penetrometer (ECP) and the Dynamic Cone Penetrometer (DCP)*

PROJECT: New Entrance Road for Clarendon Industrial Park Manning, South Carolina 218770				HAND AUGER BORING LOG: HA-3						
DATE STARTED: 11/29/22		DATE FINISHED: 11/29/22		NOTES:						
SAMPLING METHOD: Hand Auger		PERFORMED BY: W. Kannon								
WATER LEVEL: Not encountered										
Depth (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (feet)	WATER LEVEL	DYNAMIC CONE PENETRATION RESISTANCE (blows/1.75 in.)					DCP VALUE
					10	20	30	60	80	
		PLOWZONE - 9 inches								
1		CLAYEY SAND (SC) - Reddish brown, mostly fine to medium sand, some low to medium plasticity fines, moist.	132.00							
2			131.00							
3		--- Loose, orange and red, moist.	130.00							6
4		--- Loose, orange, red, and and gray, moist.	129.00							6
5		Boring terminated at 5 ft	128.00							8



DCP INDEX IS THE DEPTH (IN.) OF PENETRATION PER BLOW OF A 10.1 LB HAMMER FALLING 22.6 IN., DRIVING A 0.79 IN. O.D. 60 DEGREE CONE.

Kessler DCP Test Results

ASTM D6951/ACOE GL-92-3/ACOE GL-94-17



Project: New Entrance Roadway for Clarendon Industrial Park Date: 11/29/2022
 Project Number: 218770 Personnel: WDK
 Test Location: HA-3

Soil Type

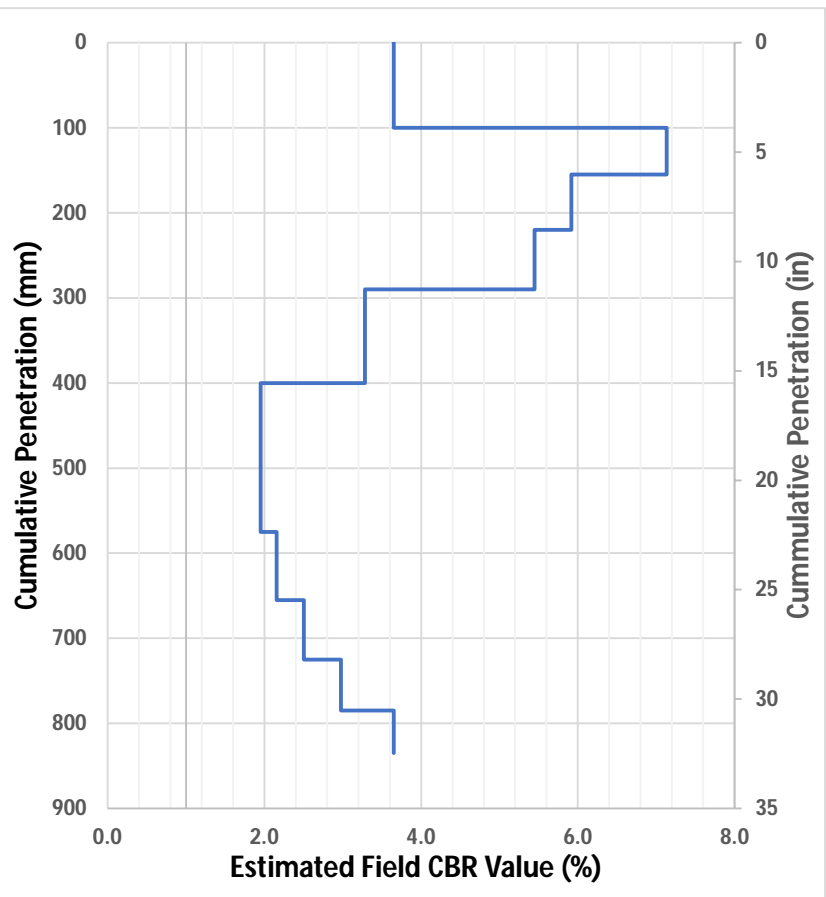
All Other Soils
 CH
 CL (estimated CBR <10)

Hammer Type

Dual 17.6 lb
 Single 10.1 lb

Test Data			
Number of Blows	Cumulative Penetration		Hammer Type
	(mm)	(in)	
0	0		1
2	100		1
2	155		1
2	220		1
2	290		1
2	400		1
2	575		1
1	655		1
1	725		1
1	785		1
1	835		1

Subgrade	
No. of Values:	10
Average CBR:	3.9
Max CBR:	7.1
Min CBR:	2.0



References:

- 1) ASTM D6951 *Standard Test Method for Use of Dynamic Cone Penetrometer in Shallow Pavement Applications*
- 2) ACOE Instruction Report GL-92-3 *Description and Application of Dual Mass Dynamic Cone Penetrometer*
- 3) ACOE Technical Report GL-94-17 *Force Protection Site Evaluation Using the Electronic Cone Penetrometer (ECP) and the Dynamic Cone Penetrometer (DCP)*

PROJECT: New Entrance Road for Clarendon Industrial Park Manning, South Carolina 218770			HAND AUGER BORING LOG: HA-4			
DATE STARTED: 11/29/22		DATE FINISHED: 11/29/22		NOTES:		
SAMPLING METHOD: Hand Auger		PERFORMED BY: W. Kannon				
WATER LEVEL: TOB = 4.5'						
Depth (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (feet)	WATER LEVEL	DYNAMIC CONE PENETRATION RESISTANCE (blows/1.75 in.)	DCP VALUE
					10 20 30 60 80	
		PLOWZONE - 11 inches				
1		CLAYEY SAND (SC) - Dark grayish brown to brown and orange, mostly fine to medium sand, some low to medium plasticity fines, wet to moist.	131.00			
2			130.00			
3		--- Loose, orange and white, moist.	129.00		●	6
4		SILTY SAND (SM) - Loose, tan and white, mostly fine to medium sand, some low plasticity fines, moist.	128.00		●	9
5		POORLY GRADED SAND WITH SILT (SP-SM) - Medium dense, tan and white, mostly fine to medium sand, few low plasticity fines, wet.	127.00	▽	●	16
Boring terminated at 5 ft						



DCP INDEX IS THE DEPTH (IN.) OF PENETRATION PER BLOW OF A 10.1 LB HAMMER FALLING 22.6 IN., DRIVING A 0.79 IN. O.D. 60 DEGREE CONE.

Kessler DCP Test Results

ASTM D6951/ACOE GL-92-3/ACOE GL-94-17



Project: New Entrance Roadway for Clarendon Industrial Park Date: 11/29/2022
 Project Number: 218770 Personnel: WDK
 Test Location: HA-4

Soil Type

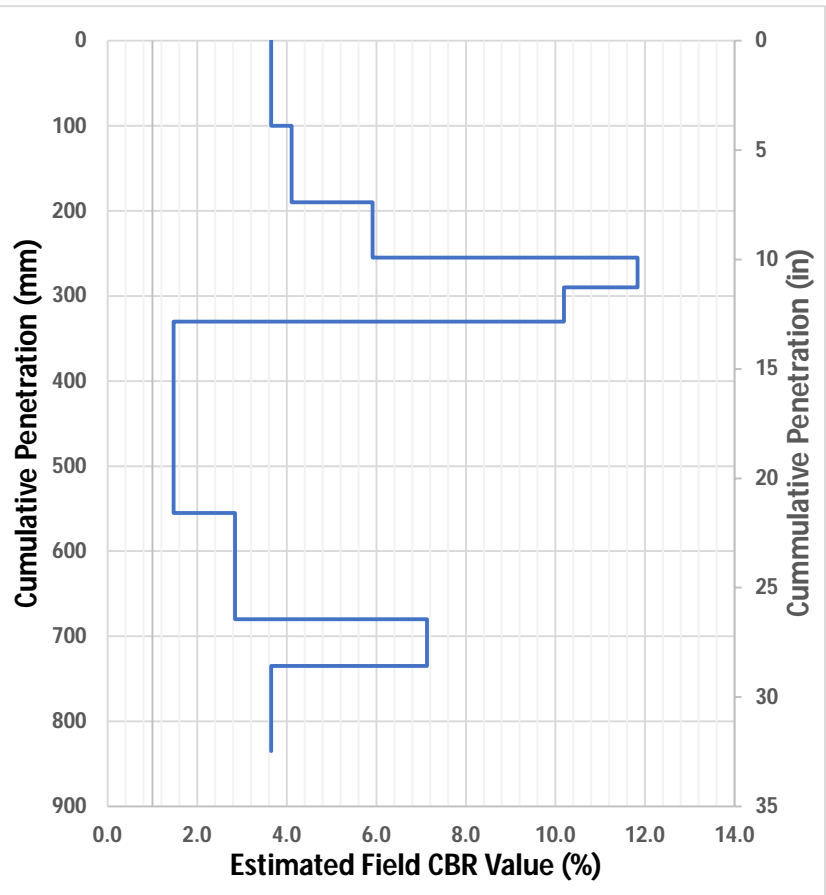
All Other Soils
 CH
 CL (estimated CBR <10)

Hammer Type

Dual 17.6 lb
 Single 10.1 lb

Test Data			
Number of Blows	Cumulative Penetration		Hammer Type
	(mm)	(in)	
0	0		1
2	100		1
2	190		1
2	255		1
2	290		1
2	330		1
2	555		1
2	680		1
2	735		1
2	835		1

Subgrade	
No. of Values:	9
Average CBR:	5.6
Max CBR:	11.8
Min CBR:	1.5



References:

- 1) ASTM D6951 *Standard Test Method for Use of Dynamic Cone Penetrometer in Shallow Pavement Applications*
- 2) ACOE Instruction Report GL-92-3 *Description and Application of Dual Mass Dynamic Cone Penetrometer*
- 3) ACOE Technical Report GL-94-17 *Force Protection Site Evaluation Using the Electronic Cone Penetrometer (ECP) and the Dynamic Cone Penetrometer (DCP)*

SECTION 03 10 00

CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Formwork for cast-in place concrete, with shoring, bracing and anchorage.
- B. Form Accessories.
- C. Expansion and Contraction Joints with Accessories.
- D. Water Stops

1.02 RELATED SECTIONS

- A. Section 03 20 00 - Concrete Reinforcing.
- B. Section 03 30 00 - Cast-In-Place Concrete.
- C. Section 07 16 16 – Crystalline Waterproofing

1.03 REFERENCES

- A. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 2010.
- B. ACI 318 - Building Code Requirements for Reinforced Concrete and Commentary; American Concrete Institute International; 2011.
- C. ACI 347R - Guide to Formwork for Concrete; American Concrete Institute International; 2004.
- D. ACI 350R – Environmental engineering Concrete Structures; American Concrete institute International; 2004.
- E. ASME A17.1 - Safety Code for Elevators and Escalators; The American Society of Mechanical Engineers; 2010.
- F. PS 1 - Construction and Industrial Plywood; National Institute of Standards and Technology (Department of Commerce); 2012.
- G. AHA A135.4 (1995) Basic Hardboard
- H. ASTM A 1011/A 1011M (2003a) Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High Strength Low-Alloy and High-Strength Low-Alloy With Improved Formability
- I. ASTM A 109/A 109M (2003) Steel, Strip, Carbon (0.25 Maximum Percent), Cold-Rolled
- J. ASTM A 167 (1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
- K. ASTM A 480/A 480M (2003b) General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
- L. ASTM C 919 (2002) Use of Sealants in Acoustical Applications

- M. ASTM C 920 (2008) Elastomeric Joint Sealants
- N. ASTM D 1751 (1999) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
- O. ASTM D 1752 (1984; R 1996e1) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
- P. ASTM D 2628 (1991; R 1998) Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
- Q. ASTM D 2835 (1989; R 1998) Lubricant for Installation of Preformed Compression Seals in Concrete Pavements
- R. ASTM D 4 (1986; R 1998) Bitumen Content
- S. ASTM D 412 (1998a; R 2002e1) Vulcanized Rubber and Thermoplastic Elastomers – Tension
- T. ASTM D 471 (1998e1) Rubber Property - Effect of Liquids
- U. ASTM D 5249 (1995; R 2000) Backer Material for Use with Cold-and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints
- V. ASTM D 5329 (1996) Sealants and Fillers, Hot-Applied, for Joints and Cracks in Asphaltic and Portland Cement Concrete Pavements
- W. COE CRD-C 513 (1974) Specifications for Rubber Waterstops
- X. COE CRD-C 572 (1974) Specifications for Polyvinylchloride Waterstops

1.04 DESIGN REQUIREMENTS

Formwork shall be designed in accordance with methodology of ACI 347 for anticipated loads, lateral pressures, and stresses. Forms shall be capable of producing a surface, which meets the requirements of the class of finish specified in Section 03300 CAST-IN-PLACE CONCRETE. Forms shall be capable of withstanding the pressures resulting from placement and vibration of concrete.

1.05 SUBMITTALS

- A. See Section 01330 - Submittals
- B. Formwork - Drawings showing details of formwork, including dimensions of panel joints, supports, studding and shoring, and sequence of form and shoring removal. Manufacturer's recommendation on method and rate of application of form release agents.
- C. Samples of form ties and method of sealing form tie hole from transmission of water in hydraulic structures.
- D. Construction and Control Joints: Layout and location for each type.
- E. Manufacturer's literature, including safety data sheets, for preformed fillers and the lubricants used in their installation; field-molded sealants and primers (when required by sealant manufacturer); preformed compression seals and preformed control joints.
- F. Water Stops - Details of splices, method of securing and supporting water stop in forms to maintain proper orientation and location during concrete placement.
- G. Samples of all proposed waterstops this includes both PVC and hydrophilic waterstops.

1.06 QUALITY ASSURANCE

Design formwork under direct supervision of a Professional Structural Engineer experienced in design of concrete formwork and licensed in the State of South Carolina.

1.07 DELIVERY, STORAGE AND HANDLING

Material delivered and placed in storage shall be stored off the ground and protected from moisture, dirt, and other contaminants. Sealants shall be delivered in the manufacturer's original unopened containers. Sealants whose shelf life has expired shall be removed from the site.

PART 2 PRODUCTS

2.01 WOOD FORM MATERIALS

- A. Form Materials: At the discretion of the Contractor.
- B. Softwood Plywood: PS 1, C Grade, Group 2.
- C. Softwood Plywood: PS 1, B-B High Density Concrete Form Overlay, Class I.
- D. Plywood: Douglas Fir species; solid one side grade; sound undamaged sheets with clean, true edges.
- E. Lumber: Straight, dressed on all sides, uniform width and thickness, free from knots, offsets, holes, dents, and other surface defects; with grade stamp clearly visible.

2.02 PREFABRICATED FORMS

- A. Manufacturers:
 - 1. Alabama Metal Industries Corporation; www.amico-online.com.
 - 2. Molded Fiber Glass Concrete Forms Co.
 - 3. Reward Wall Systems.
 - 4. SureVoid Products, Inc.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Preformed Steel Forms: Minimum 16 gage matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
- C. Preformed Plastic Forms: Thermoplastic polystyrene form liner, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
- D. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.
- E. Tubular Column Type: Round, spirally wound laminated fiber material, surface treated with release agent, non-reusable, of sizes indicated.

2.03 FORMWORK ACCESSORIES

- A. Form Ties: Removable type, galvanized metal, fixed length, cone type, with waterproofing washer, 7/8 inch back break dimension, free of defects that could leave holes larger than 1 inch in concrete surface.
- B. Water Stop Ties: For water-holding structures, basements, pipe galleries, and accessible spaces below finish grade, furnish 6-inch high polyvinylchloride waterstops. Polyvinylchloride waterstops for expansion joints shall be centerbulb type equal to No. 7C by W.R. Grace and Company, No. 9380LB by Sonneborn-Contech, RCB-6316 by BoMetals, Inc. or equal. Polyvinylchloride waterstops for construction joints shall be No. 3 by W.R. Grace and Company, No. 4316 by Sonneborn-Contech, FR-6316 by BoMetals, Inc., or equal, and as specified herein. Polyvinylchloride waterstops have the following properties:

Tensile Strength (ASTM D412)	2000 psi min.
Ultimate Elongation (ASTM D412)	350 Percent min.
Low Temperature Brittleness (ASTM D746)	(-)35 Degrees F.

Orient water stop perpendicular to tie and symmetrical about center of tie. Design ties to prevent rotation or disturbance of center portion of tie during removal of ends and to prevent water leaking along tie.

- C. Form Release Agent: Material: Release agent shall not bond with, stain, or adversely affect concrete surfaces, and shall not impair subsequent treatment of concrete surfaces when applied to forms. A ready-to-use water based material formulated to reduce or eliminate surface imperfections, containing no mineral oil or organic solvents. Environmentally safe, meeting local, state, and federal regulation and can be used in potable water facilities.
- D. Corners: Filleted, rigid plastic type; 1 x 1 inch size; maximum possible lengths.
- E. Dovetail Anchor Slot: Stainless steel, 22 gage thick, foam filled, release tape sealed slots, anchors for securing to concrete formwork.
- F. Flashing Reglets: Stainless steel, 22 gage thick, longest possible lengths, with alignment splines for joints, foam filled, release tape sealed slots, anchors for securing to concrete formwork.
- G. Nails, Spikes, Lag Bolts, Through Bolts, and Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.

2.04 CONTRACTION JOINT STRIPS

Contraction joint strips shall be, rigid polyvinylchloride (PVC) or high impact polystyrene (HIPS) insert strips specifically designed to induce controlled cracking in slabs on grade may be used. Such insert strips shall have removable top section.

2.05 PREFORMED EXPANSION JOINT FILLER

Expansion joint filler shall be pre-formed material conforming to ASTM D 1751 or ASTM D 1752. Unless otherwise indicated, filler material shall be 10 mm 3/8 inch thick and of a width applicable for the joint formed. Backer material, when required, shall conform to ASTM D 5249.

2.06 SEALANT

- A. Preformed Polychloroprene Elastomeric Type ASTM D 2628.
- B. Two Component Polyurethane, Field-Molded Type ASTM C 920, Type M, Grade P or NS, Class 25, Use T for horizontal joints. Type M, Grade NS, Class 25, Use NT for vertical

joints. Bond breaker material shall be polyethylene tape, coated paper, metal foil or similar type materials. The back-up material shall be compressible, non-shrink, nonreactive with sealant and non-absorptive material type such as extruded butyl or polychloroprene rubber.

2.07 PVC WATERSTOPS FOR EXPANSION JOINTS

- A. Provide flexible PVC (polyvinyl chloride) waterstop as manufactured by Greenstreak, profile style number 732, FR-6316 by BoMetals or approved equal. This profile has a length of 6 inches, a thickness of 3/8 inch a bulb diameter of 7/8 inch, and rib dimension of 5/8 inch.
- B. The PVC waterstop shall be extruded from an elastomeric plastic material of which the basic resin is prime virgin polyvinyl chloride. The PVC compound shall not contain any scrapped or reclaimed material or pigment whatsoever.
- C. Performance Requirements as follows:

Property	Test Method	Required Limits
Water absorption	ASTM D 570	0.15% max
Tear Resistance	ASTM D 624	200 lb/in (35 kN/m) min.
Ultimate Elongation	ASTM D 638	350% min.
Tensile Strength	ASTM D 638	2000 psi (13.78 Mpa) min.
Low Temperature Brittleness	ASTM D 746	No Failure @ -35° F (-37° C)
Stiffness in Flexure	ASTM D 747	600 psi (4.13 Mpa) min.
Specific Gravity	ASTM D 792	1.45 max.
Hardness, Shore A	ASTM D 2240	79 +3
Tensile Strength after accelerated extraction	CRD-C 572	1850 psi (11.03 Mpa) min.
Elongation after accelerated extraction	CRD-C 572	300% min.
Effect of Alkalies after 7 days: Weight Change Hardness Change	CRD-C 572	between -0.10% / +0.25% +/- 5 points

2.08 HYDROPHILIC WATERSTOP FOR NON-MOVING CONTRACTION AND CONSTRUCTION JOINTS

- A. Provide hydrophilic rubber waterstop as supplied by Greenstreak, HYDROTITE profile style number CJ-1020-2K or approved equal. This profile has a width of 0.79 inches and a height of 0.39 inches.
- B. The waterstop shall be a combination of chloroprene rubber and chloroprene rubber modified to impart hydrophilic properties.
- C. The waterstop shall have a delay coating to inhibit initial expansion due to moisture present in fresh concrete.
- D. Performance Requirements as follows:

Chloroprene Rubber

Property	Test Method	Required Limits
Tensile Strength	ASTM D 412	1300 PSI min.
Ultimate Elongation	ASTM D 412	400% min.
Hardness (Shore A)	ASTM D 2240	50 +/- 5
Tear Resistance	ASTM D 624	100 lb/inch min.

Modified Chloroprene (Hydrophilic) Rubber

Property	Test Method	Required Limits
Tensile Strength	ASTM D 412	350 PSI min.
Ultimate Elongation	ASTM D 412	600% min.
Hardness (Shore A)	ASTM D 2240	52 +/- 5
Tear Resistance	ASTM D 624	50 lb/inch
Expansion Ratio	Volumetric Change - Distilled Water at 70° F	3 to 1 min.

2.09 WATERSTOP ACCESSORIES

A. PVC Waterstops

1. Provide factory made waterstop fabrications for all changes of direction, intersections, and transitions leaving only straight butt joint splices for the field.
2. Provide hog rings or grommets spaced at 12 inches on center along length of waterstop.
3. Provide Teflon-coated thermostatically controlled waterstop splicing irons for field butt splices.

B. Hydrophilic Waterstops

1. Provide Greenstreak 7300 two-component epoxy gel or engineer approved equal to secure HYDROTITE to rough, wet (or dry) concrete.
2. Provide LEAKMASTER single-component hydrophilic sealant or engineer approved equal to secure HYDROTITE to rough, dry concrete.
3. Provide cyanoacrylate adhesive (super glue) for all splices.

PART 3 EXECUTION

3.01 ERECTION - FORMWORK

- A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301.
- B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.
- C. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.
- D. Align joints and make watertight. Keep form joints to a minimum.
- E. Obtain approval before framing openings in structural members that are not indicated on drawings.
- F. Provide fillet strips on external corners of beams, joists, columns, and walls. Fillet strips shall be placed in the forms.
- G. Install void forms in accordance with manufacturer's recommendations. Protect forms from moisture or crushing.

- H. Coordinate this section with other sections of work that require attachment of components to formwork.
- I. If formwork is placed after reinforcement, resulting in insufficient concrete cover over reinforcement, request instructions from the Engineer before proceeding.

3.02 APPLICATION - FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.
- B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
- C. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

3.03 INSERTS, EMBEDDED PARTS AND OPENINGS

- A. Provide formed openings where required for items to be embedded in passing through concrete work.
- B. Locate and set in place items that will be cast directly into concrete.
- C. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.
- D. Position recessed anchor slots for brick veneer masonry anchors to spacing and intervals specified in Section 04 05 19.
- E. Install accessories in accordance with manufacturer's instructions so they are straight, level and plumb. Ensure items are not disturbed during concrete placement.
- F. Install waterstops in accordance with manufacturer's instructions, so they are continuous without displacing reinforcement. Heat seal joints so they are watertight.
- G. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- H. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

3.04 FORM CLEANING

- A. Clean forms as erection proceeds, to remove foreign matter within forms.
- B. Clean formed cavities of debris prior to placing concrete.
 - 1. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
 - 2. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3.05 FORMWORK TOLERANCES

- A. Construct formwork to maintain tolerances required by ACI 301.

- B. Construct and align formwork for elevator hoistway in accordance with ASME A17.1.
- C. Camber slabs and beams 1/4 inch per 10 feet.
- D. Camber slabs and beams in accordance with ACI 301.

3.06 FIELD AND QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 45 00.
- B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and to verify that supports, fastenings, wedges, ties, and items are secure.
- C. Do not reuse wood formwork more than three (3) times for concrete surfaces to be exposed to view. Do not patch formwork.

3.07 FORM REMOVAL

Forms shall be removed preventing injury to the concrete and ensuring the complete safety of the structure. Formwork for columns, walls, side of beams and other parts not supporting the weight of concrete may be removed when the concrete has attained sufficient strength to resist damage from the removal operation but not before at least 24 hours has elapsed since concrete placement. Supporting forms and shores shall not be removed from beams, floors and walls until the structural units are strong enough to carry their own weight and any other construction or natural loads. Supporting forms or shores shall not be removed before the concrete strength has reached 70 percent of design strength, as determined by field cured cylinders or other approved methods. Job-cured test specimens shall demonstrate this strength, and by a structural analysis considering the proposed loads in relation to these test strengths and the strength of forming and shoring system. The job-cured test specimens for form removal purposes shall be provided in numbers as directed and shall be in addition to those required for concrete quality control. The specimens shall be removed from molds at the age of 24 hours and shall receive, insofar as possible, the same curing and protection as the structures they represent.

3.08 CONTRACTION JOINTS

Contraction joints may be constructed by inserting tempered hardboard strips or rigid PVC or HIPS insert strips into the plastic concrete using a steel parting bar, when necessary, or by cutting the concrete with a saw after concrete has set. Joints shall be approximately 1/8 inch wide and shall extend into the slab one-fourth the slab thickness, minimum, but not less than 1 inch.

3.09 JOINT STRIPS

Strips shall be of the required dimensions and as long as practicable. After the first floating, the concrete shall be grooved with a tool at the joint locations. The strips shall be inserted in the groove and depressed until the top edge of the vertical surface is flush with the surface of the slab. The slab shall be floated and finished as specified. Working of the concrete adjacent to the joint shall be the minimum necessary to fill voids and consolidate the concrete. Where indicated, the top portion of the strip shall be sawed out after the curing period to form a recess for sealer. The removable section of PVC or HIPS strips shall be discarded and the insert left in place. True alignment of the strips shall be maintained during insertion.

3.10 SAWED JOINTS

Joint sawing shall be early enough to prevent uncontrolled cracking in the slab, but late enough that this can be accomplished without appreciable spalling. Concrete sawing machines shall be adequate in number and power, and with sufficient replacement blades to complete the sawing at the required rate. Joints shall be cut to true alignment and shall be cut in sequence of concrete

placement. Sludge and cutting debris shall be removed.

3.11 EXPANSION JOINTS

Preformed expansion joint filler shall be used in expansion and isolation joints in slabs around columns and between slabs on grade and vertical surfaces where indicated. The filler shall extend the full slab depth, unless otherwise indicated. The edges of the joint shall be neatly finished with an edging tool of 1/8 inch radius, except where a resilient floor surface will be applied. Where the joint is to receive a sealant, the filler strips shall be installed at the proper level below the finished floor with a slightly tapered, dressed and oiled wood strip temporarily secured to the top to form a recess to the size shown on the drawings. The wood strip shall be removed after the concrete has set. Contractor may opt to use a removable expansion filler cap designed and fabricated for this purpose in lieu of the wood strip. The groove shall be thoroughly cleaned of laitance, curing compound, foreign materials, protrusions of hardened concrete, and any dust, which shall be blown out of the groove with oil-free compressed air.

3.12 JOINT SEALANT

Sawed contraction joints and expansion joints in slabs shall be filled with joint sealant, unless otherwise shown. Joint surfaces shall be clean, dry, and free of oil or other foreign material, which would adversely affect the bond between sealant and concrete. Joint sealant shall be applied as recommended by the manufacturer of the sealant.

3.13 JOINTS WITH FIELD-MOLDED SEALANT

Joints shall not be sealed when the sealant material, ambient air, or concrete temperature is less than 4 degrees C 40 degrees F. When the sealants are meant to reduce the sound transmission characteristics of interior walls, ceilings, and floors the guidance provided in ASTM C 919 shall be followed. Joints requiring a bond breaker shall be coated with curing compound or with bituminous paint. Bond breaker and back-up material shall be installed where required. Joints shall be primed and filled flush with joint sealant in accordance with the manufacturer's Recommendations.

3.14 WATERSTOP INSTALLATION

A. PVC Waterstop

1. Field butt splices shall be heat fused welded using a Teflon covered thermostatically controlled waterstop splicing iron at approximately 380 degrees F. Follow approved manufacturer recommendations.
2. Lapping of waterstop, use of adhesives, or solvents shall not be allowed.
3. Center waterstop in joint and secure waterstop in correct position using hog rings or grommets spaced at 12" on centers along the length of the waterstop and wire tie to adjacent reinforcing steel.

B. Hydrophilic Waterstop

1. Cut coil ends square (or at proper angle for mitered corners) with shears or sharp blade to fit splices together without overlaps.
2. Splices shall be sealed using cyanoacrylate adhesive (super glue) and LEAKMASTER.
3. Seal watertight any exposed cells of HYDROTITE using LEAKMASTER.
4. Follow approved manufacturer recommendations.

C. Hydrophilic and PVC Intersections

1. Maintain continuity of waterstops at all intersections and transitions.
2. Joinery between PVC and HYDROTITE shall be sealed using LEAKMASTER.
3. Follow approved manufacturer recommendations.

END OF SECTION

SECTION 03 20 00

CONCRETE REINFORCING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Reinforcing steel for cast-in-place concrete.
- B. Supports and accessories for steel reinforcement.

1.02 RELATED SECTIONS

- A. Section 03 10 00 - Concrete Forming and Accessories.
- B. Section 03 30 00 - Cast-In-Place Concrete.
- C. Section 07 16 16 – Crystalline Waterproofing

1.03 REFERENCES

- A. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 2010.
- B. ACI 318 - Building Code Requirements for Reinforced Concrete and Commentary; American Concrete Institute International; 2011.
- C. ACI 350R – Environmental Engineering Concrete Structures; American Concrete Institute International, 2004.
- D. ACI SP-66 - ACI Detailing Manual; American Concrete Institute International; 2004.
- E. ASTM A 82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement; 1997a.
- F. ASTM A 184/A 184M - Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement; 1996.
- G. ASTM A 185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement; 1997.
- H. ASTM A 497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement; 1997.
- I. ASTM A 615/A 615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement; 1996a.
- J. ASTM A 706/A 706M - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement; 1998.
- K. ASTM A 775/A 775M - Standard Specification for Epoxy-Coated Reinforcing Steel Bars;
- S. CRSI (DA4) - Manual of Standard Practice; Concrete Reinforcing Steel Institute; Latest Edition.
- T. CRSI (P1) - Placing Reinforcing Bars; Concrete Reinforcing Steel Institute; Latest Edition

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittals, for submittal procedures.
- B. Shop Drawings: Comply with requirements of ACI SP-66. Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.
 - 1. Prepare shop drawings under seal of a Professional Structural Engineer experienced in design of work of this type and licensed in the State of South Carolina.
- C. Manufacturer's Certificate: Certify that reinforcing steel and accessories supplied for this project meet or exceed specified requirements.
- D. Reports: Submit certified copies of mill test report of reinforcement materials analysis.
- E. Mechanical reinforcing bar splice manufacturer's information

1.05 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301.
 - 1. Maintain one copy of each document on project site.
- B. Provide with access to fabrication plant to facilitate inspection of reinforcement. Provide notification of commencement and duration of shop fabrication in sufficient time to allow inspection.
- C. Welders' Certificates: Submit certifications for welders employed on the project, verifying AWS qualification within the previous 12 months.

1.06 DELIVERY AND STORAGE

Reinforcement and accessories shall be stored off the ground on platforms, skids, or other supports. Reinforcement shall be kept covered to minimize rust and scale buildup until ready for placement.

PART 2 PRODUCTS

2.01 REINFORCEMENTS

- A. Reinforcing Steel: ASTM A 615/A 615M Grade 60 (420).
 - 1. Plain billet-steel bars.
 - 2. Unfinished.
 - 3. Shop fabricated and bent cold.
- D. Welded Steel Wire Fabric: ASTM A 185.
 - 1. Flat Sheets.
 - 2. Mesh Size and Wire Gage: As indicated on drawings.
- E. Synthetic Fiber Reinforcement: Synthetic fiber shall be polypropylene with a denier less than 100 and a nominal fiber length of 50 mm 2 inches.

- F. Reinforcement Accessories:
1. Tie Wire: Annealed, minimum 16 gage (1.5 mm).
 2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
 3. Provide stainless steel components for placement within 1-1/2 inches (38 mm) of weathering surfaces.

2.02 DEVELOPMENT AND SPLICES

- A. Conform to ACI 318, Chapter 12, and ACI 350R.
- B. Unless noted otherwise all splices shall be Class B tension laps for top bars or other bars as applicable. Refer for drawings for lap lengths.
- C. Welded wire fabric lap 9 inches, minimum.

2.03 FABRICATION

- A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice.
- B. Welding of reinforcement is not permitted unless approved by the engineer. Perform welding in accordance with AWS D1.4.
- C. Locate reinforcing splices not indicated on drawings at point of minimum stress, if feasible.
 1. Review locations of splices with the Structural Engineer.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Placing
 1. General: Reinforcing steel shall be placed in accordance with the drawings and reviewed shop drawings and the applicable requirements of the "Codes and Standards" hereinbefore specified. Install reinforcement accurately and secure against movement, particularly under the weight of workmen and the placement of concrete.
 2. Reinforcing Supports: Bars shall be supported on metal chairs or spacers on metal hangers, accurately placed and securely fastened to hold reinforcement in place. Additional bars shall be supplied whether specifically indicated on the drawings or not where necessary to securely fasten reinforcement in place. Support legs of accessories in forms without embedding in form surface. Spacing of chairs and accessories shall conform to CRSI'S "Manual of Standard Practice." Hooping and stirrups shall be accurately spaced and wired to the reinforcing. No wood will be permitted inside forms. Where the concrete surface will be exposed to the weather in the finished structure, the portions of all accessories within 1/2 inch of the concrete surface shall be noncorrosive or protected against corrosion.
- C. Slab reinforcing supports: All slab reinforcement shall be supported on approved continuous slab bolsters. To prevent feet penetration into subgrade or formwork, slab bolsters shall have a continuous base. For slabs over insulation, slab bolsters shall have a continuous plate base. Spacing of bolsters shall not exceed 4'-0" on center.

- D. Placing and Tying: All reinforcing shall be set in place, spaced, and rigidly and securely tied or wired with 16 gauge steel tie wire at all splices and at sufficient points to hold the reinforcing in its proper position. Rebending of bars on the job to fit existing conditions will not be permitted without the written approval of the Engineer. Point ends of wire ties away from forms.
- E. Spacing: Minimum center to center distance between parallel bars shall be in accordance with the details on the drawings or, where not indicated, the clear spacing shall be 2 times the bar diameter but in no case less than 1-1/2 inches nor less than 1-1/3 times the maximum size aggregate.
- F. Splices:
1. Laps of splices, where indicated on the drawings, shall be adequate to transfer stress by bond.
 2. Unless indicated otherwise on the drawings, lap bars according to ACI 318, Class B. Lap bars in masonry in accord with ACI 530, with a minimum of 48 diameters.
 3. Wherever possible, splices of adjacent bars shall be staggered.
 4. All splices not indicated shall be subject to acceptance by the Engineer.
 5. Mechanical connections for reinforcing bars shall develop 125% of the yield strength of the spliced bars.
- G. Welded Wire Fabric: Wire fabric shall be in as long lengths as practicable and shall be wired at all laps and splices. End laps shall be off-set in adjacent widths. Welded wire fabric shall be supported with approved slab bolsters and as required for slab reinforcing supports.
- H. Dowel aligners: Dowel aligner shall be installed in accordance with manufacturer's recommendations.
- I. Dowels: Dowels shall be tied securely in place before concrete is deposited. In the event there are no bars in position to which dowels may be tied, a #3 bar minimum shall be added to provide proper support and anchorage. Bending of dowels after placement of concrete will not be permitted. Templates shall be furnished for all column and pier dowels.
- J. Protective Concrete Covering: Except where indicated otherwise on drawings, the minimum concrete coverage for steel reinforcement shall be as follows:
1. Concrete cast against and permanently exposed to earth: 3 inches.
 2. Formed concrete exposed to weather or earth: 1-1/2 inches for bars No. 5 and smaller, and 2 inches for bars over No. 5 in size.
 3. Concrete not exposed to weather or in contact with ground:
 - a. Slabs, walls, joists: 3/4 inches for bars No. 11 and smaller and 1-1/2 inches for bars over No. 11 in size.
 - b. Beams, columns: Primary reinforcement, ties, stirrups, spiral: 1-1/2 inches.
- K. Placing Tolerances: Bars shall be placed to the following tolerances:
1. Clear distance to formed surfaces: $\pm 1/4$ inches.
 2. Minimum spacing between bars: $\pm 1/4$ inch.

3. Top bars in slabs and beams:
 - a. Members 8 inches deep or less: $\pm 1/4$ inch.
 - b. Members more than 8 inches but not over 2 feet deep: $\pm 1/2$ inches.
 - c. Members more than 2 feet deep: ± 1 inch.
4. Crosswise of members: Spaced evenly within 2 inches.
5. Lengthwise of members. ± 2 inches.
- L. Bars may be moved as necessary to avoid interference with other reinforcing steel, conduits or embedded items. If bars are moved more than one bar diameter, or enough to exceed the above tolerances, the resulting arrangement of bars shall be subject to acceptance by the Engineer.
- M. Cleaning: Reinforcement, at time concrete is placed, shall be free of all coatings that would impair bond to concrete.

3.02 FIELD QUALITY CONTROL

- A. Notification
 1. Subcontractor shall notify the Engineer, Building Department and Testing Laboratory at least 48 hours ahead of each concrete pour, and no concrete shall be placed until all reinforcing steel has been installed by the Subcontractor and approved by the Engineer or Testing Laboratory.
- B. Correction During Concreting
 1. Capable steel workmen shall be kept on the work at all times during the placing of concrete and shall properly reset any reinforcement displaced by runways, workmen, or other causes.
- C. Defective Work
 1. The following reinforcing steel work will be considered defective and may be ordered by the Engineer to be removed and replaced by the Subcontractor at no additional cost to the Builder or Owner.
 - a. Bars with kinks or bends not shown on Drawings.
 - b. Bars injured due to bending or straightening.
 - c. Bars heated for bending.
 - d. Reinforcement not placed in accordance with the Drawings and/or Specifications.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

This section specifies cast-in place structural concrete.

1.02 RELATED SECTIONS

- A. Section 32 16 13 - Concrete Curbs and Gutters.
- B. Section 03 10 00 - Concrete Forms and Accessories
- C. Section 03 20 00 - Concrete Reinforcement
- D. Section 07 16 16 – Crystalline Waterproofing
- E. Section 07 26 00 – Vapor Retarders

1.03 REFERENCES

- A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute International; 1991 (Reapproved 2009).
- B. ACI 211.2 - Standard Practice for Selecting Proportions for Structural Lightweight Concrete; American Concrete Institute International; 1998.
- C. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 2010.
- D. ACI 302.1R - Guide for Concrete Floor and Slab Construction; American Concrete Institute International; 1996.
- E. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute International; 1989 (Reapproved 2000).
- F. ACI 305R - Hot Weather Concreting; American Concrete Institute International; 2010.
- G. ACI 306R - Cold Weather Concreting; American Concrete Institute International; 2010.
- H. ACI 308 - Standard Practice for Curing Concrete; American Concrete Institute International; 1992 (Reapproved 2008).
- I. ACI 318 - Building Code Requirements for Reinforced Concrete and Commentary; American Concrete Institute International; 2011.
- J. ACI 350R – Environmental Engineering Concrete Structures; American Concrete Institute International; 2006.
- K. ASTM A 185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement; 1997.
- L. ASTM A 497 - Standard Specification for Steel Welded Wire fabric, Deformed, for Concrete Reinforcement; 1997.

- M. ASTM A 615/A 615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement; 1996a.
- N. ASTM C 33 - Standard Specification for Concrete Aggregates; 1999a.
- O. ASTM C 39/C 39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 1999.
- P. ASTM C 94/C 94M - Standard Specification for Ready-Mixed Concrete; 2000.
- Q. ASTM C 150 - Standard Specification for Portland Cement; 1999a.
- R. ASTM C 171 - Standard Specification for Sheet Materials for Curing Concrete; 1997a.
- S. ASTM C 173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 1994a.
- T. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete; 1998.
- U. ASTM C 309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 1998a.
- V. ASTM C 494/C 494M - Standard Specification for Chemical Admixtures for Concrete; 1999a.
- W. ASTM C 618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete; 1999.
- X. ASTM C 685 - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 1998a.
- Y. ASTM C 881 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 1999.
- Z. ASTM C 1059 - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete; 1999.
- AA. ASTM C 1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink); 1999.
- AB. ASTM E 1155 - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers; 1996.

1.04 SUBMITTALS

- A. Concrete mixture proportions shall be determined by the Contractor and submitted for review. The concrete mixture quantities of all ingredients per cubic meter yard and nominal maximum coarse aggregate size that will be used in the manufacture of each quality of concrete shall be stated. Proportions shall indicate the mass of cement, pozzolan and ground granulated blast-furnace (GGBF) slag when used, and water; the mass of aggregates in a saturated surface-dry condition; and the quantities of admixtures. The submission shall be accompanied by test reports from a laboratory complying with ASTM C 1077 which show that proportions thus selected will produce concrete of the qualities indicated. No substitution shall be made in the source or type of materials used in the work without additional tests to show the quality of the new material and concrete are satisfactory.

- B. The curing medium and methods to be used shall be submitted for review and approval.
- C. If concrete is to be placed under cold-weather conditions, the proposed materials, methods, and protection shall be submitted for approval.
- D. If concrete is to be placed under hot-weather conditions, the proposed material and methods shall be submitted for review and approval.
- E. Aggregate quality tests shall be submitted at least 30 days prior to start of concrete placement.
- F. The results of the initial mixer uniformity tests shall be submitted at least 5 days prior to the initiation of placing.
- G. Cementitious materials, including cement and pozzolan, (and Ground Granulated Blast Furnace Slag) will be accepted on the basis of the manufacturer's certification of compliance, accompanied by mill test reports that materials meet the requirements of the specification under which they are furnished. Certification and mill test reports shall be from samples taken from the particular lot furnished. No cementitious materials shall be used until notice of acceptance has been given by the Contracting Officer. Cementitious material will be subject to check testing from samples obtained at the source, at transfer points, or at the project site, as scheduled by the Contracting Officer, and such sampling will be by or under the supervision of the Owner at its expense. Material not meeting specifications shall be promptly removed from the site of work.
- H. Air-Entraining Admixture shall be certified for compliance with all specification requirements.
- I. Other chemical admixtures shall be certified for compliance with all specification requirements.
- J. Epoxy Resin and Latex Bonding Compound shall be certified for compliance with all specification requirements.
- K. Descriptive literature of the Non-shrink Grout proposed for use shall be furnished together with a certificate from the manufacturer stating that it is suitable for the application or exposure for which it is being considered.

1.05 PRE-CONCRETE CONFERENCE

- A. General: At least 15 days prior to submittal of design mixes, conduct a meeting to review proposed methods of concrete construction to achieve the required results.
- B. Agenda: Includes but is not limited to:
 - 1. Submittals.
 - 2. Coordination of work.
 - 3. Availability of material.
 - 4. Concrete mix design including admixtures.
 - 5. Methods of placing, finishing, and curing.
 - 6. Finish criteria required to obtain required flatness and levelness.
 - 7. Timing of floor finish measurements.

8. Material inspection and testing.
- C. Attendees: Include but not limited to representatives of Contractor; subcontractors involved in supplying, conveying, placing, finishing, and curing concrete; Resident Engineer; and Consulting Engineer.
- D. Minutes of the meeting: Contractor shall take minutes and type and distribute the minutes to attendees within five days of the meeting.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Portland Cement: ASTM C150 Type I, I-P, or II.
- B. Fly Ash: ASTM C618, Class C or F including supplementary optional requirements relating to reactive aggregates and alkalis, and loss on ignition (LOI) not to exceed 5 percent.
- C. Coarse Aggregate: ASTM C33.
 1. Size #57
 2. Coarse aggregate for applied topping, encasement of steel columns, and metal pan stair fill shall be Size 789.
 3. Maximum size of coarse aggregates not more than one-fifth of narrowest dimension between sides of forms, one-third of depth of slabs, nor three-fourth of minimum clear spacing between reinforcing bars.
- D. Fine Aggregate: ASTM C33. Fine aggregate for applied concrete floor topping shall pass a No. 4 sieve, 10 percent maximum shall pass a No. 100 sieve.
- E. Mixing Water: Fresh, clean – potable or reclaimed.
- F. Admixtures:
 1. Water Reducing Admixture: ASTM C494, Type A and not contain more chloride ions than are present in municipal drinking water.
 2. Water Reducing, Retarding Admixture: ASTM C494, Type D and not contain more chloride ions than are present in municipal drinking water.
 3. High-Range Water-Reducing Admixture (Superplasticizer): ASTM C494, Type F or G, and not contain more chloride ions than are present in municipal drinking water.
 4. Non-Corrosive, Non-Chloride Accelerator: ASTM C494, Type C or E, and not contain more chloride ions than are present in municipal drinking water. Admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory of at least one year duration using an acceptable accelerated corrosion test method such as that using electrical potential measures.
 5. Air Entraining Admixture: ASTM C260.
 6. Calcium Nitrite corrosion inhibitor: ASTM C494 Type C.
 7. Concrete Waterproofing Admixture shall be included for the designated structures as specified in Section 07 16 16.

8. Prohibited Admixtures: Calcium chloride, thiocyanate or admixtures containing more than 0.05 percent chloride ions are not permitted.
 9. Certification: Written conformance to the requirements above and the chloride ion content of the admixture prior to mix design review.
- R. Expansion Joint Filler: ASTM D1751.
- S. Sheet Materials for Curing Concrete: ASTM C171.
- T. Liquid Membrane-forming Compounds for Curing Concrete: ASTM C309, Type I, with fugitive dye. Compound shall be compatible with scheduled surface treatment, such as paint and resilient tile, and shall not discolor concrete surface.
- U. Non-Shrink Grout:
1. ASTM C1107, pre-mixed, produce a compressive strength of at least 2500 psi at three days and 5000 psi at 28 days. Furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95 percent bearing under a 4 foot by 4 foot base plate.
 2. Where high fluidity or increased placing time is required, furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95 percent under an 18 inch by 36 inch base plate.

2.02 CONCRETE MIX DESIGN

- A. Mix Designs: Proportioned in accordance with Section 5.3, "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318. The concrete compressive strength F_c' shall be 4,000 psi unless otherwise indicated on the drawings.
1. If trial mixes are used, make a set of at least 4 cylinders in accordance with ASTM C192 for test purposes from each trial mix; test two for compressive strength at 7 days and at 28 days.
 2. Submit a report of results of each test series, include a detailed listing of the proportions of trial mix or mixes, including cement, fly ash, admixtures, weight of fine and coarse aggregate per cubic yard measured dry rodded and damp loose, specific gravity, fineness modulus, percentage of moisture, air content, water-cement -fly ash ratio, and consistency of each cylinder in terms of slump. Include dry unit weight of lightweight structural concrete.
 3. Prepare a curve showing relationship between water-cement-fly ash ratio at 7-day and 28-day compressive strengths. Plot each curve using at least three specimens.
 4. If the field experience method is used, submit complete standard deviation analysis.
- B. After approval of mixes no substitution in material or change in proportions of approval mixes may be made without additional tests and approval of Resident Engineer or as specified. Making and testing of preliminary test cylinders may be carried on pending approval of cement and fly ash, providing Contractor and manufacturer certify that ingredients used in making test cylinders are the same. Resident Engineer may allow Contractor to proceed with depositing concrete for certain portions of work, pending final approval of cement and fly ash and approval of design mix.
- C. Cement Factor: Maintain minimum cement factors in Table I regardless of compressive strength developed above minimums. Fly ash may be substituted for up to 20 percent of

the minimum cement factor at option of Contractor, except fly ash may not be used in concrete designated as architectural concrete.

TABLE I - CEMENT AND WATER FACTORS FOR CONCRETE

Concrete Strength	Water/Cement Ratio
Min. 28 Day Comp. Str. psi	Max. Water Cement Ratio
4000 ¹ ,	0.45

1. If trial mixes are used, the proposed mix design shall achieve a compressive strength 1200 psi in excess of f'c.
- D. Maximum Slump: Maximum slump, as determined by ASTM C143 with tolerances as established by ASTM C94, for concrete to be vibrated shall be as shown in Table II.

TABLE II - MAXIMUM SLUMP, INCHES

Type of Construction	Normal Weight Concrete
Reinforced Footings and Substructure Walls	3 inches
Slabs, Beams, Reinforced Walls, and Building Columns	4 inches

- E. Slump may be increased by the use of the approved high-range water-reducing admixture (superplasticizer). Tolerances as established by ASTM C94. Concrete containing the high-range-water-reducing admixture may have a maximum slump of 9 inches. The concrete shall arrive at the job site at a slump of 2 inches to 3 inches. This should be verified, and then the high-range-water-reducing admixture added to increase the slump to the approved level.
- F. Air-Entrainment: Air-entrainment of normal weight concrete shall conform to Table III. Air-entrainment of lightweight structural concrete shall conform to Table IV. Determine air content by either ASTM C173 or ASTM C231.

TABLE III - TOTAL AIR CONTENT

Location	Air Content
Concrete Exposed to Weather	4.0% to 6.0%

- G. Concrete slabs placed at air temperatures below 50 degrees Fahrenheit use non-corrosive, non-chloride accelerator. Concrete required to be air entrained use approved air entraining admixture. Pumped concrete, synthetic fiber concrete, architectural concrete, concrete required to be watertight, and concrete with a water/cement ratio below 0.50 use high-range water-reducing admixture (superplasticizer).
- H. Durability: Use air entrainment for exterior exposed concrete subjected to freezing and thawing and other concrete shown or specified. Air content as shown in Table III.
- I. Enforcing Strength Requirements: Test as specified in Section 01 45 23, TESTING LABORATORY SERVICES, during the progress of the work. Seven-day tests may be used as indicators of 28-day strength. Average of any three 28-day consecutive strength tests of laboratory-cured specimens representing each type of concrete shall be equal to or greater than specified strength. No single test shall be more than 500 psi below specified strength. Interpret field test results in accordance with ACI 214. Should strengths shown

by test specimens fall below required values, Resident Engineer may require any one or any combination of the following corrective actions, at no additional cost to the Owner:

1. Require changes in mix proportions by selecting one of the other appropriate trial mixes or changing proportions, including cement content, of approved trial mix.
2. Require additional curing and protection.
3. If five consecutive tests fall below 95 percent of minimum values given in Table I or if test results are so low as to raise a question as to the safety of the structure, Resident Engineer may direct Contractor to take cores from portions of the structure. Use results from cores tested by the Contractor retained testing agency to analyze structure.
4. If strength of core drilled specimens falls below 85 percent of minimum value given in Table I, Resident Engineer may order load tests, made by Contractor retained testing agency, on portions of building so affected. Load tests in accordance with ACI 318 and criteria of acceptability of concrete under test as given therein.
5. Concrete work, judged inadequate by structural analysis, by results of load test, or for any reason, shall be reinforced with additional construction or replaced, if directed by the Resident Engineer.

PART 3 EXECUTION

3.01 PREPARATION

A. Mixing

1. All concrete shall be ready-mixed concrete and shall be mixed and delivered in accordance with the requirements of "Specifications for Ready-Mixed Concrete", ASTM C94 and ACI 318 to produce concrete with the required strength, slump and air content.
2. The concrete producer shall furnish with each load of concrete a numbered delivery ticket showing name of Contractor, name and location of project, date and time batched, truck number, number of cubic yards in load, specified strength, slump, and mix design number.
3. In the event concrete is mixed at a central batching plant, the delivery shall be arranged so that intervals between batches are kept at a minimum, and in any event not more than thirty (30) minutes. Trucks shall be in first class condition and kept in constant rotation during delivery.
4. When concrete is delivered in a truck mixer or agitator, no water from the truck water system or elsewhere shall be added after the initial introduction of mixing water for the batch, except when on arrival at the job site the slump of the concrete is less than that specified. Such additional water to bring the slump within required limits shall be injected into the mixer, provided the maximum water-cement ratio specified is not exceeded. The drum or blades shall be turned an additional 30 revolutions or more at mixing speed until the concrete is within the proper slump limits.

- B. Discharge of concrete after initial batching shall be completed within 90 minutes, or before the drum has revolved 300 revolutions, whichever comes first, after the introduction of the mixing water to the cement and aggregates. In hot weather (as defined by ACI) the discharge of the concrete shall be completed within 60 minutes.

- C. Maximum delivery temperature of concrete shall be 100°F. Minimum delivery temperature as follows:

Atmospheric Temperature	Minimum Concrete Temperature
30 degrees to 40 degrees F	60 degrees F
0 degrees to 30 degrees F	70 Degrees F

3.02 VAPOR BARRIER

- A. Except where membrane waterproofing is required, interior concrete slab on grade shall be placed on a continuous vapor barrier as specified in Section 07 19 00.
1. Vapor barrier joints lapped 6 inches and sealed with compatible waterproof pressure-sensitive tape.
 2. Patch punctures and tears.

3.03 CONSTRUCTION JOINTS

- A. Unless otherwise shown, location of construction joints to limit individual placement shall not exceed 95 feet in any horizontal direction, except slabs on grade which shall have construction joints shown. Allow 48 hours to elapse between pouring adjacent sections unless this requirement is waived by Resident Engineer.
- B. Locate construction joints in suspended floors near the quarter-point of spans for slabs, beams or girders, unless a beam intersects a girder at center, in which case joint in girder shall be offset a distance equal to twice width of beam. Provide keys and inclined dowels as shown. Provide longitudinal keys as shown.
- C. Place concrete for columns slowly and in one operation between joints. Install joints in concrete columns at underside of deepest beam or girder framing into column.
- D. Allow 2 hours to elapse after column is cast before concrete of supported beam, girder or slab is placed. Place girders, beams, grade beams, column capitals, brackets, and haunches at the same time as slab unless otherwise shown.
- E. Install polyvinyl chloride or rubber water seals, as shown in accordance with manufacturer's instructions, to form continuous watertight seal. Waterstops selection shall be defined in specification section 03100 Concrete Forms and Accessories.

3.04 EXPANSION JOINTS

- A. Clean expansion joint surfaces before installing pre-molded filler and placing adjacent concrete.
- B. Where indicated install polyvinyl chloride or rubber water seals, as shown in accordance with manufacturer's instructions, to form continuous watertight seal and as specified in Section 03 10 00.

3.05 PLACING CONCRETE

- A. Preparation:
1. Remove hardened concrete, wood chips, shavings and other debris from forms.
 2. Remove hardened concrete and foreign materials from interior surfaces of mixing and conveying equipment.

3. Have forms and reinforcement inspected and approved by Resident Engineer before depositing concrete.
 4. Provide runways for wheeling equipment to convey concrete to point of deposit. Keep equipment on runways which are not supported by or bear on reinforcement. Provide similar runways for protection of vapor barrier on coarse fill.
- B. Bonding: Before depositing new concrete on or against concrete which has been set, thoroughly roughen and clean existing surfaces of laitance, foreign matter, and loose particles.
1. Preparing surface for applied topping:
 - a. Remove laitance, mortar, oil, grease, paint, or other foreign material by sand blasting. Clean with vacuum type equipment to remove sand and other loose material.
 - b. Broom clean and keep base slab wet for at least four hours before topping is applied.
 - c. Use a thin coat of one part Portland cement, 1.5 parts fine sand, bonding admixture; and water at a 50:50 ratio and mix to achieve the consistency of thick paint. Apply to a damp base slab by scrubbing with a stiff fiber brush. New concrete shall be placed while the bonding grout is still tacky.
- C. Conveying Concrete: Convey concrete from mixer to final place of deposit by a method which will prevent segregation. Method of conveying concrete subject to approval of Resident Engineer.
- D. Placing: For special requirements see Paragraphs, HOT WEATHER and COLD WEATHER.
1. Do not place concrete when weather conditions prevent proper placement and consolidation, or when concrete has attained its initial set, or has contained its water or cement content more than 1-1/2 hours.
 2. Deposit concrete in forms as near as practicable in its final position. Prevent splashing of forms or reinforcement with concrete in advance of placing concrete.
 3. Do not drop concrete freely more than 10 feet for concrete containing the high-range water-reducing admixture (superplasticizer) or 5 feet for conventional concrete. Where greater drops are required, use a tremie or flexible spout (canvas elephant trunk), attached to a suitable hopper.
 4. Discharge contents of tremies or flexible spouts in horizontal layers not exceeding 20 inches in thickness, and space tremies such as to provide a minimum of lateral movement of concrete.
 5. Continuously place concrete until an entire unit between construction joints is placed. Rate and method of placing concrete shall be such that no concrete between construction joints will be deposited upon or against partly set concrete, after its initial set has taken place, or after 45 minutes of elapsed time during concrete placement.
 6. On bottom of members with severe congestion of reinforcement, deposit 1 inch layer of flowing concrete containing the specified high-range water-reducing admixture (superplasticizer). Successive concrete lifts may be a continuation of this concrete or concrete with a conventional slump.

7. Concrete on metal deck:
 - a. Concrete on metal deck shall be minimum thickness shown. Allow for deflection of steel beams and metal deck under the weight of wet concrete in calculating concrete quantities for slab.
- E. Consolidation: Conform to ACI 309. Immediately after depositing, spade concrete next to forms, work around reinforcement and into angles of forms, tamp lightly by hand, and compact with mechanical vibrator applied directly into concrete at approximately 18 inch intervals. Mechanical vibrator shall be power driven, hand operated type with minimum frequency of 5000 cycles per minute having an intensity sufficient to cause flow or settlement of concrete into place. Vibrate concrete to produce thorough compaction, complete embedment of reinforcement and concrete of uniform and maximum density without segregation of mix. Do not transport concrete in forms by vibration.
 1. Use of form vibration shall be approved only when concrete sections are too thin or too inaccessible for use of internal vibration.
 2. Carry on vibration continuously with placing of concrete. Do not insert vibrator into concrete that has begun to set.

3.06 HOT WEATHER

- A. Follow the recommendations of ACI 305 or as specified to prevent problems in the manufacturing, placing, and curing of concrete that can adversely affect the properties and serviceability of the hardened concrete. Methods proposed for cooling materials and arrangements for protecting concrete shall be made in advance of concrete placement and approved by Resident Engineer.

3.07 COLD WEATHER

- A. Follow the recommendations of ACI 306 or as specified to prevent freezing of concrete and to permit concrete to gain strength properly. Use only the specified non-corrosive, non-chloride accelerator. Do not use calcium chloride, thiocyanates or admixtures containing more than 0.05 percent chloride ions. Methods proposed for heating materials and arrangements for protecting concrete shall be made in advance of concrete placement and approved by Resident Engineer.

3.08 PROTECTION AND CURING

- A. Conform to ACI 308: Initial curing shall immediately follow the finishing operation. Protect exposed surfaces of concrete from premature drying, wash by rain and running water, wind, mechanical injury, and excessively hot or cold temperatures. Keep concrete not covered with membrane or other curing material continuously wet for at least 7 days after placing, except wet curing period for high-early-strength concrete shall be not less than 3 days. Keep wood forms continuously wet to prevent moisture loss until forms are removed. Cure exposed concrete surfaces as described below. Other curing methods may be used if approved by Resident Engineer.
 1. Liquid curing and sealing compounds: Apply by power-driven spray or roller in accordance with the manufacturer's instructions. Apply immediately after finishing. Maximum coverage 400 square feet per gallon on steel troweled surfaces and 300 square feet per gallon on floated or broomed surfaces for the curing/sealing compound.
 2. Plastic sheets: Apply as soon as concrete has hardened sufficiently to prevent surface damage. Utilize widest practical width sheet and overlap adjacent sheets 2 inches. Tightly seal joints with tape.

3. Paper: Utilize widest practical width paper and overlap adjacent sheets 2 inches. Tightly seal joints with sand, wood planks, pressure-sensitive tape, mastic or glue.

3.09 REMOVAL OF FORMS

- A. Remove in a manner to assure complete safety of structure after the following conditions have been met.
 1. Where structure as a whole is supported on shores, forms for beams and girder sides, columns, and similar vertical structural members may be removed after 24 hours, provided concrete has hardened sufficiently to prevent surface damage and curing is continued without any lapse in time as specified for exposed surfaces.
 2. Take particular care in removing forms of Architectural exposed concrete to insure surfaces are not marred or gouged, and that corners and arises are true, sharp and unbroken.
- B. Control Test: Use to determine if the concrete has attained sufficient strength and curing to permit removal of supporting forms. Cylinders required for control tests taken in accordance with ASTM C172, molded in accordance with ASTM C31, and tested in accordance with ASTM C39. Control cylinders cured and protected in the same manner as the structure they represent. Supporting forms or shoring not removed until strength of control test cylinders have attained at least 70 percent of minimum 28-day compressive strength specified. For post-tensioned systems supporting forms and shoring not removed until stressing is completed. Exercise care to assure that newly unsupported portions of structure are not subjected to heavy construction or material loading.

3.10 CONCRETE SURFACE PREPARATION

- A. Metal Removal: Unnecessary metal items cut back flush with face of concrete members.
- B. Patching: Maintain curing and start patching as soon as forms are removed. Do not apply curing compounds to concrete surfaces requiring patching until patching is completed. Use cement mortar for patching of same composition as that used in concrete. Use white or gray Portland cement as necessary to obtain finish color matching surrounding concrete. Thoroughly clean areas to be patched. Cut out honeycombed or otherwise defective areas to solid concrete to a depth of not less than 1 inch. Cut edge perpendicular to surface of concrete. Saturate with water area to be patched, and at least 6 inches surrounding before placing patching mortar. Give area to be patched a brush coat of cement grout followed immediately by patching mortar. Cement grout composed of one part Portland cement, 1.5 parts fine sand, bonding admixture, and water at a 50:50 ratio, mix to achieve consistency of thick paint. Mix patching mortar approximately 1 hour before placing and remix occasionally during this period without addition of water. Compact mortar into place and screed slightly higher than surrounding surface. After initial shrinkage has occurred, finish to match color and texture of adjoining surfaces. Cure patches as specified for other concrete. Fill form tie holes which extend entirely through walls from unexposed face by means of a pressure gun or other suitable device to force mortar through wall. Wipe excess mortar off exposed face with a cloth.
- C. Upon removal of forms, clean vertical concrete surface that is to receive bonded applied cementitious application with wire brushes or by sand blasting to remove unset material, laitance, and loose particles to expose aggregates to provide a clean, firm, granular surface for bond of applied finish.

3.11 CONCRETE SLAB FINISHES

- A. General
 1. Finish slab concrete per the requirements of ACI 302.1R.

2. Use manual screeds, vibrating screeds, or roller compacting screeds to place concrete level and smooth.
3. Do not use "jitterbugs" or other special tools designed for purpose of forcing coarse aggregate away from surface and allowing layer of mortar, which will be weak and cause surface cracks or delamination, to accumulate.
4. Do not dust surfaces with dry materials.
5. Round off edges of slabs with steel edging tool, except where cove finish is shown. Steel edging tool radius shall be 1/4 inch for slabs subject to wheeled traffic.

B. Type S-1 (Bull Float Finish):

1. Finish slab to receive fill and mortar setting bed by screeding with straightedges to bring surface to required finish plane.
2. Wood float finish to compact and seal surface.
3. Remove laitance and leave surface clean.
4. Coordinate with other finish procedures.

C. Type S-2 (Steel Troweled Finish):

1. Finish by screeding and floating with straightedges to bring surfaces to required finish elevation. Use evaporation retardant.
2. While concrete is still green, but sufficiently hardened to bear a person's weight without deep imprint, wood float to true, even plane with no coarse aggregate visible.
3. Use sufficient pressure on wood floats to bring moisture to surface.
4. After surface moisture has disappeared, hand trowel concrete to produce smooth, impervious surface, free from trowel marks.
5. Burnish surface with an additional troweling. Final troweling shall produce ringing sound from trowel.
6. Do not use dry cement or additional water during troweling, nor will excessive troweling be permitted.
7. Power Finishing:
 - a. Approved power machine may be used in lieu of hand finishing in accordance with directions of machine manufacturer.
 - b. Do not use power machine when concrete has not attained necessary set to allow finishing without introducing high and low spots in slab.

D. Type S-3 (Underside Elevated Slab Finish): When forming is removed, grind off projections on underside of slab and patch defective areas, including small shallow air pockets where schedule of concrete finishes requires:

1. Prepare surfaces for painting as specified in Section 09 90 00, Painting and Coating.

- E. Type S-4 (Broomed Finish):
 - 1. Finish as specified for Type S-1 floor finish, except omit final troweling and finish surface by drawing fine-hair broom lightly across surface.
 - 2. Broom in same direction and parallel to expansion joints, or, in the case of inclined slabs, perpendicular to slope, except for round roof slab, broom surface in radial direction.

3.12 CONCRETE SLAB TOLERANCES

- A. Concrete Thickness Tolerances shall be 3/8 inch greater or 1/4 inch less than specified as specified in ACI code section 117.
- B. Concrete Level Tolerances shall be F_F25 as defined in ACI code section 117 or 1/4 inch gap under an unlevelled 10 ft. straightedge.
- C. Slope slabs to floor drain and gutter, and shall adequately drain regardless of tolerances.

3.13 CONCRETE WALL FINISHES

- A. Type W-1 (Ordinary Wall Finish):
 - 1. Point & Patch tie holes.
 - 2. Knock off projections.
 - 3. Patch defective areas.
- B. Type W-2 (Smooth Wall Finish):
 - 1. Point & Patch tie holes.
 - 2. Grind off projections, fins, and rough spots.
 - 3. Patch defective areas and repair rough spots resulting from form release agent failure or other reasons to provide smooth uniform appearance.
- C. Type W-3 (Finish for Painting):
 - 1. Point & Patch tie holes.
 - 2. Grind off projections, fins, and rough spots.
 - 3. Patch and repair defective areas as specified for Type W-2.
 - 4. Leave surface ready for painting as specified in Section 09 90 00, Painting and Coating.
- D. Type W-4 (Smooth Rubbed Wall Finish):
 - 1. Only water curing will be permitted on walls being rubbed.
 - 2. Patch and repair defective areas as specified for Type W-2.
 - 3. Perform rubbing while green concrete can be physically worked and smoothed without adding other materials, if structurally possible, the day following placement. Finish no later than 3 days after placement has been completed.

4. Remove forms at such a rate that all finishing, form tie filling, fin removal, and patching can be completed on same day forms are removed while curing wall.
5. After pointings have set sufficiently to permit working on surface, thoroughly saturate entire surface with water for period of 3 hours and rub until uniform surface is obtained.
6. Rub either by hand with carborundum stone of medium-coarse grade or abrasive of equal quality, or mechanically operated carborundum stone.
7. Mechanically operated carborundum stones shall be approved by Engineer before concrete finishing.
8. No cement grout, other than cement paste drawn from the concrete itself by the rubbing process shall be used.
9. Finish Paste Formed by Rubbing by Either Brushing or Floating as Follows:
 - a. Brushing:
 - i. Carefully strike with clean brush.
 - ii. Brush in long direction of surface being finished.
 - b. Floating:
 - i. Spread uniformly over surface and allow to reset.
 - ii. Finish by floating with canvas, carpet face, or cork float, or rub down with dry burlap.
9. Continue water curing of wall during finishing operation in areas not being rubbed.
10. Move water curing onto rubbed areas as soon as water will not erode rubbed surface.

E. Type W-5 (Cementitious water-proof coating)

1. Patch and repair defective areas as specified for Type W-2.
2. Substrate must be clean, sound, and free of surface contaminants. Remove dust, laitance, grease, oils, curing compounds, form release agents and all foreign particles by mechanical means. An open-textured, sandpaper-like substrate is ideal. Substrate shall be in accordance with ICRI Guideline No. 03732 for coatings and fall within CSP4. All surfaces must be saturated surface dry (SSD), with no standing water at time of application.
3. Apply cementitious water proof coating identified as Thoroseal by ChemRex, Inc., Sealcoat 1000 by Dayton Superior, or SikaTop 144 by the Sika Corporation (contractor selection) per the manufacturer's recommendations and as described below:
 - a. Thoroseal by ChemRex Inc.
 1. Prepare a mixing solution of 1 part Acryl 60 and 3 parts water.
 2. Mix one 50-pound bag of Thoroseal with 8 quarts of mixing solution from item 1 above.

3. 1st coat shall be applied at a rate of 225 sq. feet per 50lb bag.
 4. 2nd coat shall be applied at a rate of 450 sq. feet per 50lb bag.
- b. Sealcoat 1000 by Dayton Superior
1. Prepare a mixing solution of 1 part Ad Bond (J-40) to 3 parts clean water.
 2. Mix one 50lb bag of Sealcoat 1000 with 8 quarts of mixing solution from item 1 above.
 3. 1st coat shall be applied at a rate of 225 sq. feet per 50lb bag.
 4. 2nd coat shall be applied at a rate of 450 sq. feet per 50lb bag.
- c. Sikatop 144 by Sika Corporation
1. Mix components A and B at a 1:1.647 by weight ratio
 2. 1st coat 100 sq. feet per gallon
 3. 2nd coat 150 sq. feet per gallon

3.14 CONCRETE WALL TOLERANCES

- A. Concrete Wall Tolerances shall be as defined in specification section "03 10 00 Concrete Forming and Accessories" and as indicated in ACI code section 301.

3.15 BEAM AND COLUMN FINISHES (B=Beam, C=Column)

- A. Type B-1: Match wall Type W-1.
- B. Type B-2: Match wall Type W-2.
- C. Type B-3: Match wall Type W-3
- D. Type B-4: Match wall Type W-4
- E. Type B-5: Match wall Type W-5
- F. Type C-1: Match wall Type W-1.
- G. Type C-2: Match wall Type W-2.
- H. Type C-3: Match wall Type W-3
- I. Type C-4: Match wall Type W-4
- J. Type C-5: Match wall Type W-5.

3.16 CONCRETE BEAM AND COLUMN TOLERANCES

- A. Concrete Beam and Column Tolerances shall be as defined in specification section "03 10 00 Concrete Forming and Accessories" and as indicated in ACI code section 301.

3.17 BACKFILL AGAINST WALLS

- A. Do not backfill against walls until concrete has obtained specified 28 day compressive strength.
- B. Place backfill simultaneously on both sides of wall, where required, to prevent differential pressures.

3.18 FIELD QUALITY CONTROL

- A. General:
 - 1. Provide adequate facilities for safe storage and proper curing of concrete test cylinders onsite for first 24 hours, and for additional time as may be required before transporting to test lab.
 - 2. Provide concrete for testing of slump, air content, and for making cylinders from the point of discharge into forms. When concrete is pumped, Samples used shall be taken from discharge end of pump hose.
 - 3. Evaluation will be in accordance with ACI 301, Chapter 17 and Specifications.
 - 4. Specimens shall be made, cured, and tested in accordance with ASTM C31 and ASTM C39.
 - 5. Frequency of testing may be changed at discretion of Engineer.
 - 6. Pumped Concrete: Take concrete samples for slump (ASTM C143) and test cylinders (ASTM C31 and C39) and shrinkage specimens (ASTM C157) at placement (discharge) end of line.
 - 7. Reject concrete represented by cylinders failing to meet strength and air content specified.

END OF SECTION

SECTION 03 30 00.10

TESTING OF HYDRAULIC STRUCTURES

PART 1 GENERAL

1.01 SCOPE

- A. Furnish all labor, materials, tools, equipment and related items required to perform integrity and leakage tests of hydraulic structures. This includes all water/wastewater retaining structures. This does not include manholes, which are tested as specified elsewhere.

1.02 SUBMITTALS

- A. Submittals shall conform to the requirements of Section 01 30 00 of these Specifications and shall include a description of the testing procedures to be employed and the report form to be furnished. Testing procedure shall follow ACI 350.1 R-2004.

PART 2 PRODUCTS

2.01 TEST MEDIUMS

- A. The Owner will provide the necessary potable water required for testing the Work. The Contractor shall furnish all other test mediums. The Contractor shall furnish all equipment, pumping, necessary piping and required labor to transport water from its source to the test location for use in testing and to empty any tankage at conclusion of test.

2.02 TEST EQUIPMENT

- A. The Contractor shall furnish all labor and equipment, including required pumps with regulated bypass meters and gauges, for conducting tests

PART 3 EXECUTION

3.01 GENERAL

- A. The timing and sequence of testing shall be scheduled by the Contractor, subject to the approval of the Engineer. The Contractor shall coordinate the timing and sequence of testing with the Owner's operating schedule. The Contractor shall provide the Engineer with a minimum of 48 hours' notice prior to the start of any test. All tests must be observed by the Engineer.
- B. The Contractor shall repair any leaks discovered during the testing sequence. All known and visible leaks shall be repaired, whether or not the leakage rate is within allowable limits. Concrete tanks shall not be backfilled prior to testing. A visible leak shall be defined as water flow from cracks, joints, fittings, etc. Isolated surface dampness shall not be considered a leak.

3.02 NON-POROUS STRUCTURES

- A. Non-porous structures, such as steel and fiberglass, shall be tested for 24 hours. Accurate and precise measurements shall be made at the beginning and end of the test period. The structure shall be filled with water to its maximum depth. No leakage is allowed during the 24 hour test period.

3.03 CONCRETE STRUCTURES

- A. Test Preparation - Concrete structures shall be tested prior to any backfill (provided design of structure allows for it) and prior to application of any coatings. Structures shall be filled to the highest allowable point and water shall remain in structure a minimum of three days prior to

commencement of testing.

- B. Allowable leaking Rate = 0.1% of the tank volume over a 24-hr period. Example: 1,000,000 gallon tank x 0.1% = 1000 gallons allowable leakage; Assume tank has a 100 ft. diameter; $1000 \text{ gal} \times 0.1337 = 133.7 \text{ ft}^3$; $\text{PI} (50)^2 h = 133.7 \text{ ft}^3$; $h=0.2$ inches allowable water level drop in 24 hours.
- C. Compensation for temperature, evaporation, and precipitation shall be made by using a filled calibrated container. The container shall be floating in the water containment structure. This container will allow for corrections due to the above.
- D. Test Procedure. Concrete structures shall be tested for 24 hours. Accurate and precise measurements of the water level in the containment structure and the compensating vessel shall be made at the beginning and end of test. Leakage shall not exceed allowable in item B above.

3.04 REPAIRS

- A. If the leakage exceeds the specified allowable limits or is visible, the point or points of leakage shall be sought out and remedied by the Contractor at no additional cost to the Owner. Repairs shall be accomplished in a method submitted by the Contractor and approved by the Engineer.

3.05 ACCEPTANCE

- A. No hydraulic structure shall be accepted until all known and visible leaks have been repaired, whether or not the leakage is within the maximum allowable limits. Repairs must be made prior to backfill for concrete tanks.
- B. The Contractor will certify that all required tests have been successfully completed before the work is accepted.

END OF SECTION

SECTION 03 40 00
PRECAST CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Lintels and bond beams.
- B. Wetwells
- C. Utility Vaults
- D. Manholes
- E. Headwalls

1.02 RELATED SECTIONS

- A. 03 30 00 - Cast-In Place Concrete

1.03 REFERENCES

- A. ACI 318 - Building Code Requirements for Reinforced Concrete and Commentary; American Concrete Institute International; 2014.
- B. ASTM A 36/A 36M - Standard Specification for Carbon Structural Steel; 1997a.
- C. ASTM A 153/A 153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 1998.
- D. ASTM A 185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement; 1997.
- E. ASTM A 416/A 416M - Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete; 1998.
- F. ASTM A 497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement; 1997
- G. ASTM A 615/A 615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement; 1996a.
- H. ASTM A 666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 1999.
- I. ASTM A 767/A 767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement; 1997.
- J. ASTM C 150 - Standard Specification for Portland Cement; 1999a.
- K. AWS D1.1 - Structural Welding Code - Steel; American Welding Society; 2000.
- L. AWS D1.4 - Structural Welding Code - Reinforcing Steel; American Welding Society; 1998.
- M. PCI MNL-116S - Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products; Precast/Prestressed Concrete Institute; 2013, Tenth Edition.

- N. PCI MNL-120 - PCI Design Handbook - Precast and Prestressed Concrete; Precast/Prestressed Concrete Institute; 1999.
- O. PCI MNL-123 - Design and Typical Details of Connections for Precast and Prestressed Concrete; Precast/Prestressed Concrete Institute; 1988, Second Edition.

1.04 DESIGN REQUIREMENTS

- A. Size components to withstand design loads in a restrained condition as follows:
 - 1. Horizontal Assembly: 150 psf live and dead loads.
 - 2. Vertical Assembly: 20 psf wind load.
 - 3. As shown on the drawings.
- B. Maximum Allowable Deflection: 1/180 span.
- C. Design members exposed to the weather to provide for movement of components without damage, failure of joint seals, undue stress on fasteners or other detrimental effects, when subject to seasonal or cyclic day/night temperature ranges.
- D. Design system to accommodate construction tolerances, deflection of other building structural members and clearances of intended openings.
- E. Shall be manufactured in accordance with Prestressed Concrete Institute's Manual 116 Manual for quality control for plans and production of Precast, prestressed concrete products and SC D.O.T. Standard Specifications.

1.05 SUBMITTALS

- A. See Section 01 33 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Indicate standard component configurations, design loads, deflections, cambers, and bearing requirements.
- C. Shop Drawings: Indicate layout, unit locations, fabrication details, unit identification marks, reinforcement, connection details, support items, dimensions, openings, and relationship to adjacent materials. Indicate design loads, deflections, cambers, bearing requirements, and special conditions.
- D. Samples: Submit two panels, 24 x 24 inches (610 x 610 mm) in size, illustrating surface finish treatment.
- E. Design Data: Submit design data reports indicating calculations for loadings and stresses of fabricated, designed framing.

1.06 QUALITY ASSURANCE

- A. Perform work of this section in accordance with requirements of PCI MNL-116S, PCI MNL-120, and PCI MNL-123.
- B. Fabricator Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- C. Erector Qualifications: Company specializing in erecting products of this section with minimum five (5) years of documented experience.

- D. Design precast concrete members under direct supervision of a Professional Structural Engineer experienced in design of precast concrete and licensed in the State of South Carolina.
- E. Welder: Qualified within previous 12 months in accordance with AWS D1.1 and AWS D1.4.

1.07 REGULATORY REQUIREMENTS

Conform to ACI 318 for design load and construction requirements applicable to work of this section.

1.08 PRE-INSTALLATION MEETING

- A. Convene a pre-installation conference one week prior to commencing work of this section.
- B. Instruct others when field cutting of required openings are 10 inches (254 mm) and smaller.

1.09 DELIVERY, STORAGE AND HANDLING

- A. Handle precast members in position consistent with their shape and design. Lift and support only from support points.
- B. Lifting or Handling Devices: Capable of supporting member in positions anticipated during manufacture, storage, transportation, and erection.
- C. Protect members to prevent staining, chipping, or spalling of concrete.
- D. Mark each member with date of production and final position in structure.

1.10 PROJECT/SITE CONDITIONS

Coordinate the work of framing components not pre-tensioned but associated with the work of this section.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Precast Concrete:
 - 1. Sherman Precast.
 - 2. Tindall Concrete Products.
 - 3. Hanson
 - 4. Approved Equal.

2.02 MATERIALS

- A. Cement: White Portland, conforming to ASTM C 150, Type I.
- B. Aggregate, Sand, Water, Admixtures: Determined by precast fabricator as appropriate to design requirements and PCI MNL-116S.

2.03 REINFORCEMENT

- A. Tensioning Steel Tendons: ASTM A 416/A 416M, Grade 250 (1725); seven-wire stranded steel cable; low-relaxation type; full length without splices; uncoated.
- B. Reinforcing Steel: ASTM A 615/A 615M Grade 60 (420).
 - 1. Plain billet-steel bars.
 - 2. Unfinished.
 - 3. Shop fabricated and bent cold.
- C. Welded Steel Wire Fabric: ASTM A 185 plain type; in flat sheets; unfinished.

2.04 ACCESSORIES

- A. Connecting and Supporting Devices: Plates, angles, items cast into concrete, and inserts conforming to PCI MNL-123, and as follows:
 - 1. Material: Carbon steel conforming to ASTM A 36/A 36M.
 - 2. Finish: Prime painted, except where device surfaces will be in contact with concrete or will require field welding.
- B. Grout:
 - 1. Non-shrink, non-metallic, minimum yield strength of 10,000 psi (69 MPa) at 28 days.
 - 2. Epoxy.
- C. Bearing Pads: High density plastic, Vulcanized elastomeric compound molded to size, Neoprene (Chloroprene), or Tetrafluoroethylene (TFE); Shore A Durometer; 1/8 inch (3 mm) thick, smooth both sides.
- D. Bolts, Nuts and Washers: High strength steel type recommended for structural steel joints.

2.05 FABRICATION

- A. Fabrication procedure to conform to PCI MNL-116S.
- B. Maintain plant records and quality control program during production of precast members. Make records available upon request.
- C. Ensure reinforcing steel, anchors, inserts, plates, angles, and other cast-in items are embedded and located as indicated on shop drawings.
- D. Tension reinforcement tendons as required to achieve design load criteria.
- E. Provide required openings with a dimension larger than 10 inches (250 mm) and embed accessories provided under other sections of the specifications, at indicated locations.

2.06 FINISHES

- A. Ensure exposed-to-view finish surfaces of precast concrete members are uniform in color and appearance.

- B. Cure members under identical conditions to develop required concrete quality, and minimize appearance blemishes such as non-uniformity, staining, or surface cracking.
- C. Architectural Finish: Surface holes or bubbles over 1/4 inch (6 mm) filled with matching cementitious paste, fins or protrusions removed and surface ground smooth.
- D. Precast manufacturer shall coat inside of all wet well structures and receiving manholes (manhole force main discharges into) with two-component, self-priming, chemically cured, coal tar epoxy protective coating.

2.07 FABRICATION TOLERANCES

- A. Conform to PCI MNL-116S.
- B. Maximum Variation from Nominal Dimension: 1 inch (25 mm).
- C. Maximum Variation from Intended Camber: 5/8 inch (15 mm).
- D. Maximum Out of Square: 1/8 inch/10 feet (3 mm/3 m), non-cumulative.
- E. Maximum Misalignment of Anchors, Inserts, Openings: 1/8 inch (3 mm).
- F. Maximum Bowing of Members: Length of Bow/ 360.

2.08 SOURCE QUALITY CONTROL AND TESTS

- A. Section 01 40 00 - Quality Requirements: Provide mix design for concrete.
- B. Test samples in accordance with applicable ASTM standard.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that site conditions are ready to receive work and field measurements are as shown on shop drawings.

3.02 PREPARATION

- A. Prepare support equipment for the erection procedure, temporary bracing, and induced loads during erection.

3.03 WETWELLS, UTILITY VAULTS AND MANHOLES

- A. Concrete bases may be precast or cast-in-place. The concrete base of precast and cast-in-place structures shall be placed on an (eight) 8-inch No. 57 stone mat or as shown on the drawings. Each precast section shall have not more than two holes for the purpose of handling and laying. These holes shall be tapered and shall be plugged with rubber stoppers or mortar installation. Brick or concrete ring to support cover shall be a minimum of 3 inches high but not more than 18 inches high.
- B. Openings larger than 1-1/2 inches in diameter shall be precast into the appropriate section.
- C. Any openings added during construction shall be approved by the precast manufacturer and be formed by coring. No other method for adding holes will be considered.
- D. Joints of the precast sections shall be tongue and groove type. Sections shall be joined using O-ring rubber gaskets conforming to ASTM C443 or preformed mastic sealer. In

addition, the joint shall be sealed inside and out with cement mortar using one part Portland cement to two parts clean sand meeting ASTM C144. The joints shall be watertight.

- E. Shaped bottoms shall be as shown on the drawings. They shall be constructed of one monolithic pour using 3000-psi concrete.
- F. Brickwork required to complete the precast concrete structures shall be constructed using mortar of one part Portland cement to two parts clean sand, meeting ASTM C144 and thoroughly mixed to a workable plastic consistency.
- G. Any damage to the coating during storage, handling, transportation or installation of the section shall be repaired immediately to provide complete coverage and protection per manufacturer's recommendations. Mortar joints shall receive two (2) coats of waterproofing after the section is installed and the mortar has set and dried.

3.04 ERECTION

- A. Erect members without damage to structural capacity, shape, or finish. Replace or repair damaged members.
- B. Align and maintain uniform horizontal and vertical joints, as erection progresses.
- C. Maintain temporary bracing in place until final support is provided. Protect members from staining.
- D. Provide temporary lateral support to prevent bowing, twisting, or warping of members.
- E. Adjust differential camber between precast members to tolerance before final attachment.
- F. Install bearing pads.
- G. Level differential elevation of adjoining horizontal members with grout to maximum slope of 1:12.
- H. Set vertical units dry, without grout, attaining joint dimension with lead or plastic spacers.
- I. Grout underside of column bearing plates.
- J. Secure units in place. Perform welding in accordance with AWS D1.1.

3.05 ERECTION TOLERANCES

- A. Erect members level and plumb within allowable tolerances.
- B. Conform to PCI MNL-116S.
- C. Design and erect to the following tolerances:
 - 1. Maximum Variation from Plane or Location Indicated on Drawings: 1/4 inch/10 feet and 3/8 inch in 100 feet (6 mm/3 m and 9 mm in 30 mm), non-cumulative.
 - 2. Maximum Offset from True Alignment between Members: 1/4 inch (6 mm).
 - 3. Maximum Variation from Dimensions Indicated on Reviewed Shop Drawings: Plus or minus 1/8 inch (3 mm).
- D. Exposed Joint Dimension: 3/8 inch (9 mm) plus or minus 1/4 inch (6 mm).

- E. When members cannot be adjusted to conform to design or tolerance criteria, cease work and advise the Engineer. Execute modifications as directed.

3.06 PROTECTION

- A. Protect members from damage caused by field welding or erection operations.
- B. Provide non-combustible shields during welding operations.

3.07 CLEANING

Clean weld marks, dirt, or blemishes from surface of exposed members.

END OF SECTION

SECTION 03 48 10

PRECAST CONCRETE MANHOLES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Precast concrete manholes for sanitary sewers and water lines or as indicated on the Construction Drawings.
- B. Precast concrete sanitary sewer manholes with fiberglass liner or sewer gas resistance epoxy coating where corrosion resistant manholes are specifically required to prevent early deterioration of the manhole.
- C. Pile-supported concrete foundation used for unstable subgrade treatment for manhole base.

1.02 SUBMITTALS

- A. Conform to requirements of Section - Submittals.
- B. Submit manufacturer's data and details of following items for approval:
 - 1. Shop drawings of manhole sections, base units and construction details, including reinforcement, jointing methods, materials and dimensions.
 - 2. Summary of criteria used in manhole design including, as minimum, material properties, loadings, load combinations, and dimensions assumed. Include certification from manufacturer that precast manhole design is in full accordance with ASTM C 478 and design criteria as established in Paragraph 2.01E of this Specification.
 - 3. Frames, grates, rings, and covers
 - 4. Materials to be used in fabricating drop connections
 - 5. Materials to be used for pipe connections at manhole walls.
 - 6. Materials to be used for stubs and stub plugs, if required.
 - 7. Materials and procedures for corrosion-resistant liner and coatings, if required.
 - 8. Plugs to be used for sanitary sewer hydrostatic testing
 - 9. Manufacturer's data for pre-mix (bag) concrete, if used for channel inverts and benches.

PART 2 PRODUCTS

2.01 PRECAST CONCRETE MANHOLES

- A. Provide manhole sections, base sections, and related components conforming to ASTM C 478. Provide base riser section with integral floors, unless shown otherwise. Provide adjustment rings which are standard components of manufacturer of manhole sections. Mark date of manufacture and name or trademark of manufacturer on inside of barrel.

- B. Construct barrels for precast manholes from standard reinforced concrete manhole sections of diameter indicated on the Construction Drawings. Use various lengths of manhole sections in combination to provide correct height with fewest joints.
- C. Provide tops to support AASHTO HS-20 vehicle loading, and receive cast iron frame covers, as indicated on the Construction Drawings.
- D. For manholes larger than 48-inch diameter, provide precast base sections with flat slab top precast sections used to transition to 48-inch diameter manhole access riser sections. Transition can be concentric or eccentric unless otherwise requested by Alliance Consulting Engineers, Inc. Locate transition to provide minimum of 7-foot head clearance from base to underside of transition unless otherwise approved by Alliance Consulting Engineers, Inc.
- E. Design Loading Criteria: Manhole walls, transition slabs, cone tops, and manhole base slab shall be designed by manufacturer, to requirements of ASTM C 478 for depth as shown on the Construction Drawings and to resist the following loads.
 - 1. AASHTO HS-20 vehicle loading applied to manhole cover and transmitted down to transition and base slabs
 - 2. Unit soil weight of 120 lbs/ft³ located above portions of manhole, including base slab projections
 - 3. Lateral soil pressure based on saturated soil conditions producing an at-rest equivalent fluid pressure of 100 lbs/ft³
 - 4. Internal liquid pressure based on unit weight of 63 lbs/ft³
 - 5. Dead load of manhole sections fully supported by transition and base slabs
- F. Provide joints between sections with o-ring gaskets conforming to ASTM C443.
- G. When base is cast monolithic with portion of vertical section, extend reinforcing in vertical section into base.
- H. Precast Concrete Base: Suitable cutouts or holes to receive pipe and connections. Lowest edge of holes or cutouts: For water line manhole, no less than 6-inches above inside surface of floor of base.

2.02 CONCRETE

- A. Conform to requirements of Section - Cast-In-Place Concrete.
- B. Channel Inverts: Use concrete for inverts not integrally formed with manhole base, with minimum compressive strength of 4000 psi.
- C. Concrete Foundation: Provide concrete with minimum compressive strength of 4000 psi for concrete foundation slab under manhole base section as indicated on the Construction Drawings.

2.03 REINFORCING BARS

- A. Conform to the requirements of Section 03 30 00 – Cast-In-Place Concrete.

2.04 FRAMES AND COVERS

- A. Use castings for frames, grates, rings and covers conforming to ASTM A48, Class 35B.
- B. Use clean castings capable of withstanding application of AASHTO M306- 40,000 pound proof loading without detrimental permanent deformation.
- C. Fabricate castings to conform to shapes and dimensions as shown on the Contract Drawings, and cast with the wording or logo "SEWER" for sanitary sewer and "WATER" for water system frames and covers. Standard dimensions for manhole frames and covers shall be either 24 or 30-inches in diameter as indicated on the Contract Drawings.
- D. Castings shall be smooth and clean, and free from blowholes and other surface imperfections. Use clean and symmetrical cast holes in covers, free of plugs.
- E. Provide watertight manhole frames and covers when the top of the frame and cover is below the 50-year flood elevation or when subjected to ponding. Watertight manhole frames and covers shall be provided with minimum of four bolts and gasket designed to seal cover to frame. Supply approved watertight manhole covers and frames. Watertight manhole covers, where indicated on Drawings, shall be equivalent to Neenah Foundary Co., No. R-1916-F (bolt down). All bolts or screws shall be stainless steel.

2.05 DROP CONNECTIONS AND STUBS

- A. All manhole drop connections shall be inside drop or as noted. Drops shall be provided when the invert elevation into the manhole is 24-inches higher than the manhole invert.
 - 1. Pipe material used for outside drops shall be same pipe material as sewer main, or;
 - 2. Ductile iron pipe as indicated on the Contract Drawings.

2.06 PIPE CONNECTIONS TO MANHOLE

- A. Sanitary Sewers.
 - 1. Provide resilient connectors conforming to requirements of ASTM C923. Use the following materials for metallic mechanical devices as defined in ASTM C923:
 - a. External clamps: Type 304 stainless steel
 - 1) Internal, expandable clamps on standard manholes: Type 304 stainless steel, 11 gauge minimum.
 - 2) Internal, expandable clamps on corrosion-resistant manholes:
 - b. Type 316 stainless steel, 11 gauge minimum
 - c. Type 304 stainless steel, 11 gauge minimum, coated with minimum 16 mil fusion - bonded epoxy conforming to AWWA C213
 - 2. Where rigid joints between pipe and cast-in-place manhole base are specified, provide polyethylene - isoprene waterstop meeting physical property requirements of ASTM C923.

B. Water Lines

1. Where smooth exterior pipes, i.e., steel, ductile iron, or PVC pipes are connected to manhole base or barrel, seal space between pipe and manhole wall with assembly consisting of rubber gasket or links mechanically compressed to form a watertight barrier.
2. When connecting concrete or cement mortar coated steel pipes, or as option for connecting smooth exterior pipes to manhole base or barrel, space between pipe and manhole wall may be sealed with an assembly consisting of a stainless steel power sleeve, stainless steel take - up clamp and a rubber gasket. Take - up clamp: Minimum of 9/16-inch wide.

2.07 SEALANT MATERIALS

- A. Provide sealing materials between precast concrete adjustment ring and manhole cover frame in accordance with ASTM C443.

2.08 CORROSION RESISTANT MANHOLE MATERIALS

- A. Where corrosion - resistant manholes are required, such as a manhole receiving a force main or manholes located within a 1,000 feet down-stream of a force discharge, provide a fiberglass liner or sewer gas resistant epoxy coating for precast cylindrical manhole section, base sections, and cone sections. Liners relying on mechanically fastened batten strips as primary means of anchorage are unacceptable. All manholes with a corrosion resistant interior coating shall be provided with an exterior bituminous coating in locations where ground water table can reach above the base of the manhole.

2.09 BACKFILL MATERIALS

- A. Conform to requirements of Section 31 23 33 - Excavation Backfill and Compaction for Utilities.

2.10 NON-SHRINK GROUT

- A. Provide prepackaged, inorganic, flowable, non-gas-liberating, non-metallic, cement-based grout requiring only addition of water.
- B. Meet requirements of ASTM C1107 and have a minimum 28-day compressive strength of 7000 psi.

2.11 VENT PIPES

- A. Provide an external vent pipe for manholes for every third manhole when three or more consecutive water tight frame and covers are installed.
- B. Vent opening to be located a minimum of 1 foot above 100 year flood plain.
- C. Buried Vent Pipes: Provide appropriate size PVC or DIP as indicated on the Drawings.
- D. Vent Outlet Assembly: Provide vent outlet assembly as shown on the Construction Drawings.

2.12 PROHIBITED MATERIALS

- A. Do not use brick masonry for construction of sanitary sewer manholes, including adjustment of manholes to grade. Use only specified materials listed herein.

2.13 MANHOLE LADDER

- A. Manhole Ladder: Fiberglass with 300-lb rating at appropriate length; conform to requirements of OSHA.
 - 1. Use components, including rungs, made of fiberglass, fabricated with nylon or aluminum rivets and/or epoxy. Apply non-skid coating to ladder rungs. Mount ladder using manufacturer's recommended hardware.
 - 2. Fiberglass: Premium type polyester resin, reinforced with fiberglass; constructed to provide complete wetting of glass by resin; resistant to rot, fungi, bacterial growth and adverse effects of acids, alkalis and residential and industrial waste; yellow in color.
- B. Provide approved petroleum-based tape encapsulating bolts in access manhole.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that lines and grades are correct.
- B. Obtain an adequate foundation for all manhole structures by removing and replacing unsuitable material with well-graded granular material, by tightening with coarse rock, or by such other means as provided for foundation preparation of the connected sewers, or as directed by Alliance Consulting Engineers, Inc.
- C. Dewater sufficiently to maintain the ground water level at or below the bottom of the manhole foundation prior to and during the placement of the foundation.
- D. Do not build manholes in ditches, swales, or drainage paths unless approved by Alliance Consulting Engineers, Inc.

3.02 PLACEMENT

- A. Install precast manholes to conform to locations and dimensions as shown on the Contract Drawings.
- B. Place sanitary manholes at points of change in alignment, grade, size, pipe intersections, and end of sewer unless otherwise directed by Alliance Consulting Engineers, Inc.

3.03 MANHOLE BASE SECTIONS AND FOUNDATIONS

- A. Place precast base on 6-inch thick (minimum) foundation of crushed stone, or concrete foundation slab.
- B. Unstable Subgrade Treatment: Notify Alliance Consulting Engineers, Inc. immediately when unsuitable material is encountered in the manhole subgrade. With Alliance Consulting Engineers, Inc. approval, up to 12-inches of additional undercut may be permitted to achieve suitable foundation. If the additional undercut does not result in a satisfactory foundation, the Contractor shall obtain a bedding design prepared by a Geotechnical Engineer licensed in the State of South Carolina.

3.04 PRECAST MANHOLE SECTIONS

- A. Install sections, joints, and gaskets in accordance with manufacturer's printed recommendations.
- B. Install precast adjustment rings above tops of cones or flat-top sections as required to adjust finished elevation and to support manhole frame.
- C. Seal any lifting holes with non-shrink grout.
- D. Where fiberglass liners are required, seal joints between sections in accordance with manufacturer's recommendations.
- E. Precast concrete grade rings shall be permitted to achieve the required grade. Grade rings shall not be permitted to more than 12-inches.
- F. External joint wrap all riser joints to ensure seal. No grout is permitted on the interior of manhole riser joints prior to testing.
- G. Concrete base must be dry prior to setting any sections above it.

3.05 PIPE CONNECTIONS AT MANHOLES

- A. Install approved resilient connectors at each pipe entering and exiting manholes in accordance with manufacturer's instructions.
 - 1. Where smooth exterior pipes, i.e. steel, ductile iron or PVC pipes are connected to manhole base or barrel, space between pipe and manhole wall shall be sealed with an assembly consisting of rubber gaskets or links mechanically compressed to form watertight barrier.
 - 2. When connecting concrete or cement mortar coated steel pipes, or as an option for connecting smooth exterior pipes to manhole base or barrel, space between pipe and manhole wall may be sealed with an assembly consisting of stainless steel power sleeve, stainless steel take-up clamp and rubber gasket. Take-up clamp: Minimum of 9/16-inch wide.
- B. Ensure no concrete, fill, or other rigid material is allowed to enter space between pipe and edge of wall opening at and around resilient connector on either interior or exterior of manhole. If necessary, fill space with compressible material to ensure full flexibility provided by resilient connector.
- C. Where new manhole is constructed on existing sewer, rigid joint pipe may be used. Install waterstop gasket around existing pipe at center of cast-in-place wall. Join ends of split waterstop material at pipe springline using an adhesive recommended and supplied by waterstop manufacturer.
- D. Test connection for watertight seal before backfilling, or at direction of Alliance Consulting Engineers, Inc.

3.06 INVERTS FOR SANITARY SEWERS

- A. Construct invert channels to provide smooth flow transition waterway with no disruption of flow at pipe-manhole connections. Conform to following criteria:
 - 1. Slope of invert bench: 1-inch per foot minimum; 1-1/2 inches per foot maximum.

2. Depth of bench to invert:
 - a. Pipes smaller than 15 inches: one-half of largest pipe diameter
 - b. Pipes 15 to 24 inches: three-fourths of largest pipe diameter
 - c. Pipes larger than 24-inches: equal to largest pipe diameter
 3. Invert slope through manhole: 0.17 foot (2-inches) drop across manhole with smooth transition of invert through manhole, unless otherwise indicated on Drawing.
- B. Form invert channels with concrete if not integral with manhole base section. For direction changes of mains, construct channels tangent to mains with maximum possible radius of curvature. Provide curves for side inlets and smooth invert fillets for flow transition between pipe inverts.

3.07 DROP CONNECTIONS FOR SANITARY SEWERS

- A. Install drop connection when sewer line enters manhole higher than 24 inches above invert of manhole
- B. Backfill drop assembly shall be 3000 psi concrete to form solid encasement for all drop connections. Extend concrete encasement minimum of 4 inches outside bells, all per the Construction Drawings.

3.08 STUBS FOR FUTURE CONNECTIONS

- A. In manholes, where future connections are indicated on the Construction Drawings, install resilient connectors and pipe stubs with approved watertight plugs.

3.09 MANHOLE FRAME AND ADJUSTMENT RINGS

- A. Combine precast concrete or HDPE adjustment rings so elevation of installed casting cover matches pavement surface. Seal between concrete adjustment ring and precast top section with non-shrink grout; do not use mortar between adjustment rings. Apply latex-based bonding agent to precast concrete surfaces joined with non-shrink grout. Set cast iron frame on adjustment ring in bed of approved sealant material. Install sealant bed consisting of two beads of sealant, each bead having minimum dimensions of 1/2-inch and 1/2-inch wide.
- B. Wrap manhole frame and adjustment rings with external sealing material, minimum 3-inches beyond joint between ring and frame and adjustment rings and precast section.
- C. For manholes in unpaved areas, set top of frame flush with existing grade upto a maximum of 12-inches above existing grade, unless otherwise noted. In unpaved areas, encase manhole frame in mortar or non-shrink grout placed flush with face of manhole ring and top edge of frame. Provide rounded corner around perimeter.

3.10 BACKFILL

- A. Place and compact backfill materials in area of excavation surrounding manholes in accordance with requirements of Section 31 23 33 - Excavation Backfill and Compaction for Utilities.
- B. Where rigid joints are used for connecting existing sewers to manhole, backfill existing sewer up to springline of pipe with flowable fill.

- C. In unpaved areas, provide positive drainage away from all manhole frames to natural grade. Provide restoration of disturbed areas in accordance with Section 32 92 00 – Turf and Grasses.

3.11 DOGHOUSE MANHOLE

- A. Existing sewer pipe to remain until satisfactory completion of manhole testing.
- B. Crown of existing pipe shall be flush with concrete shelf that is formed within the manhole.
- C. Doghouse manholes, if required, shall be constructed as per the Construction Drawings.

3.12 FIELD QUALITY CONTROL

- A. Conduct testing of manholes in accordance with requirements of Section 33 01 30.13 - Acceptance Testing for Sanitary Sewers.

3.13 PROTECTION

- A. Protect manholes from damage until Work has been accepted. Repair damage to manholes at no additional cost to the Owner.

3.14 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

- A. Manholes, drop connections, manhole vent pipes, existing manhole removal and existing manhole abandonment shall be paid for at the unit prices specified in the Bid. All prices shall be for full payment for all labor, materials, tools, equipment, backfilling, sheeting, shoring, dewatering, and other costs necessary to complete the work as shown, directed and specified.
- B. Manholes are to be measured and the depth determined as the vertical distance between top of the cast iron frame and the lowest pipe invert rounded to the nearest foot.
- C. Drop Connections will be measured and paid for at the price per vertical foot, rounded to the nearest foot.
- D. Payment for manholes constructed over existing sewers shall be lump sum for each specialty manhole identified, including all appurtenances for a complete installation at each location identified.

END OF SECTION

SECTION 05 53 10

ALUMINUM HATCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

Furnish and install factory fabricated aluminum access hatches with any appurtenances necessary to complete the work shown in the drawings or specified.

1.02 RELATED SECTIONS

- A. Section 03 30 00 - Cast-In-Place Concrete.
- B. Section 03 40 00 - Precast Concrete

1.03 REFERENCES

- A. ASTM A 653/A 653M – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 1999a.
- B. ASTM A 666 – Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 1999.
- C. ASTM B 209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 1996.
- D. ASTM B 221 – Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 1996.

1.04 SYSTEM DESCRIPTION

- A. All access hatches shall be double, or single leaf as shown on the drawings. Automatic doors shall be equipped with a minimum of two stainless steel hinges with stainless steel pins. Each door leaf shall also have spring operators with a positive hold open arm that engages automatically in full open position, and a non-corrosive release handle. Doors shall open with a maximum lift force of 9 lbs. When closed, doors shall not protrude above the operating surface in which they are installed. Include slam lock feature with removable key.
- B. When subject to vehicular traffic, cover shall be reinforced to support an AASHTO H-20 wheel load with a maximum deflection of 1/150th of the span.

1.05 SUBMITTALS

- A. Submit under provisions of Section 01 30 00 – Administrative Requirements.
- B. Submit fully dimensioned shop drawings with physical characteristics of aluminum hatches including clearances and embedment details.
- C. Product data; manufacturer's specifications and technical data, including installation instructions with catalog cut sheets.
- D. Manufacturer to provide minimum 25-year warranty prior to contract closeout. Should a part fail to function under normal use during this period, manufacturer shall furnish a new part at no charge.

1.06 DELIVERY, STORAGE AND HANDLING

- A. The Contractor shall be responsible for the delivery, storage, and handling of products.
- B. Promptly remove damaged products from the job site. Replace damaged products with undamaged products.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Acceptable manufacturers for all access hatch doors shall be selected from the following:
 - 1. Thompson Fabricating Company
 - 2. Bilco, Inc.
 - 3. Halliday Products
 - 4. Approved equal

2.02 MATERIALS

- A. Door leaves shall be 1/4-inch aluminum checkered plate reinforced with structural aluminum channels, capable of withstanding 300 pounds per square foot uniform load with minimal deflection.
- B. The gutter frame provided shall be of 1/4-inch aluminum with an anchor flange around the perimeter. Frame shall incorporate a 1-1/2 inch threaded drain fitting and neoprene gasket.
- C. The drain coupling shall be located in an appropriate corner of each channel frame away from the access steps.
- D. Factory finish shall be mill finish.
- E. Hardware shall be stainless steel.
- F. Any surface or portion of the frame contacting concrete shall receive a bituminous coating.
- G. The door shall open to 90 degrees and lock automatically in that position. A vinyl grip handle shall be provided to release and close the cover with one hand.
- H. Doors, which are to receive flooring, shall be smooth plate. Doors which will not receive flooring shall be checkered plate

2.03 ACCESSORIES

Floor Doors: When flush mounted hatches and doors are furnished, provide two wrenches for opening hatches.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install hatches and doors in accordance with manufacturer's recommendations and as specified in this section.
- B. Cast flush mounted hatches and doors into concrete slabs.

- C. Secure curb hatches with stainless steel bolts and seal joint between curb and concrete.
- D. Hatches shall be uniformly supported. Lids shall operate smoothly without binding
- E. Flush mounted hatch and door covers, when closed, shall not protrude above the operating surface in which they are installed, unless otherwise indicated.
- F. Hatch Drains: Drains in watertight flush mounted hatches shall be piped to the outer edge of their respective slabs with 1-1/2 inch Schedule 80 PVC pipe.
 - 1. Where drain outlets are below the surrounding grade, not less than 7 cubic feet of crushed stone shall be placed around the outlet to ensure drainage.

3.02 CLEANING

All equipment installed under this Section shall be cleaned and adjusted for proper operation to the satisfaction of the Engineer.

END OF SECTION

ELECTRICAL, GENERAL

PART 1 – GENERAL

1.01 FEES

- a. Fees for permits and inspections are included. Deliver permits and certificates to the Architect.

1.02 SITE VISIT

- a. Prior to bidding, this Contractor shall visit the job site and shall familiarize themselves with all conditions under which work is to be performed and shall include in their bid all labor, material and operations required for a complete job.

1.03 DRAWINGS AND SPECIFICATIONS

- a. Drawings do not indicate all hardware and fittings. Examine all plans and specifications for the project and conditions at site and arrange work accordingly, furnishing required fittings and hardware without extra charge. If a conflict exists, the greater quantity or better quality, in the opinion of the Engineer, governs.
- b. Drawings and specifications are complementary; work called for in either shall be provided as if called for by both.

1.04 CODES AND STANDARDS

- a. Materials, equipment and installation shall conform to the requirements of the codes and standards (latest editions) listed below. In addition, all materials, equipment, and devices shall meet the requirements of the Underwriters' Laboratories, Inc. The label of, or listing by, the Underwriters' Laboratories, Inc. will be accepted as conforming with this requirement. In lieu of the label or listing, the Contractor may submit independent proof satisfactory to the Engineer that the materials, equipment or devices conform to the published standards, including methods of tests, of the Underwriters' Laboratories, Inc. (UL), National Electrical Code (NEC), National Electrical Safety Code, American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), Institute of Electrical and Electronics Engineers (IEEE), National Electrical Manufacturers Association (NEMA), Illuminating Engineering Society (IES), National Fire Protection Association (NFPA), National Electrical Contractors Association Standard Practices for Good Workmanship in Electrical Contracting (NECA 1), International Building Code (IBC) and Americans with Disabilities Act (ADA). And South Carolina Department of Health and Environmental Control (SCDHEC).

1.05 BASIC MATERIALS AND METHODS

- a. All materials installed shall be new, clean, in good condition and shall meet applicable provisions of codes and standards listed above.
- b. Workmanship shall be in accordance with best practice. Comply with National Electrical Contractors Association Standard Practices for Good Workmanship in Electrical Contracting (NECA 1).
- c. All materials and equipment shall be installed in accordance with manufacturer guidelines and installation instructions.

1.06 SCOPE

- a. Provide all labor, equipment, material, and operations required for complete, safe and quietly-operating electrical systems in accordance with specifications and drawings and subject to terms and conditions of the contract.
- b. The work includes:
 - i. Grounding in accordance with specifications, drawings and codes
 - ii. Complete distribution system for power including panelboards, safety switches, feeders, branch circuits, and connections to outlets and devices for power utilization
 - iii. Complete lighting system including power supplies, branch circuits, lighting fixtures, poles and associated hardware, controls, switches, outlets and switching circuits
 - iv. Raceways and conductors for pump station control and instrumentation equipment
 - v. Emergency power system
 - vi. Power supply connections to pump station equipment
 - vii. Cutting, patching, trenching, and backfilling as required for provision of the work
 - viii. Provision of new, raceways, handholes and related underground electrical work
 - ix. Firestopping and caulking as required

1.07 CUTTING AND PATCHING

- a. Provide under this contract all cutting and patching of curbs, sidewalks, walls, floors, partitions, ceilings, etc. required for proper installation of the new system.
- b. Provide patching to match existing adjacent finishes. Paint type, brand and color shall be in accordance with Owner's painting standards.
- c. Do not cut joists, beams, girders, columns, or other structural members without written permission from Owner.
- d. Relocation of existing conduit, equipment, wiring, etc. as required for installation of new system is included in this work. Perform all work in accordance with specifications for new work of the particular type involved.

1.08 EXCAVATING AND BACKFILLING

- a. Provide under this contract all excavating, and backfilling required for the installation of electrical work.
- b. Contractor shall notify Engineer prior to backfilling. Do not begin backfilling until Owner's representative has observed the work. Excavations shall be filled as soon as possible and not left open for prolonged periods.
- c. Provide safety (warning) barricades around all open trenches and holes before leaving unattended. Do not leave exposed wiring in a trench unattended.
- d. Backfilling shall be done in layers of 6 inches fill, wetted down and tamped for each consecutive layer up to grade to a compaction of at least 95 percent of AASHTO T-99-49 Proctor Curve.
- e. Whenever trenches have not been properly filled, or if settlement occurs, they shall be refilled, smoothed off and finally made to conform to the surface of the ground. Backfilling shall be carefully performed and the original surface restored to original conditions to the full satisfaction of the Engineer.

1.09 PENETRATIONS

- a. All penetrations through walls, floors, enclosures, partitions and the like shall be sealed tight.

1.1 SEISMIC RESTRAINTS

- A. Provide seismic restraint of new electrical systems and equipment as required by applicable versions of International Building Code (IBC) and ASCE 7. Seismic restraint products shall be by Mason Industries, TOLCO, Unistrut Corporation, Grinnell Corporation, Amber Booth, Peabody or approved equal.

1.2 DAMAGES

- A. Cost of repairing damage to building, building contents, and site during construction and guarantee period resulting from this work is a part of this contract.

1.3 MATERIAL AND EQUIPMENT

- A. New and as specified or approved equal.
- B. Where several units of one type of equipment are used, all units shall be products of the same manufacturer.
- C. Any increase in the cost of this work, resulting from substitution of any product or products for those specified is part of this contract. Such work shall be accomplished in an approved manner at no extra cost to the Owner.

1.4 OPERATING INSTRUCTIONS, PANELBOARD DIRECTORIES AND NAMEPLATES

- A. Instruct owner in operation of all systems.
- B. Install in each panelboard a single-sided plastic-covered, typewritten circuit directory in metal frame. Indicate name, address and service telephone number of installer. Directory shall list the load served and the location of the load for each breaker.
- C. Nameplates Provided by Contractor: On all panelboards, disconnect switches, transformers and enclosures, provide engraved plastic laminate nameplates. Unless otherwise noted, nameplates to be 1/16" thick plastic with 1/4" high white letters on black background. Attach nameplates with epoxy cement or screws. On main switchboard/panelboard and feeder distribution panelboards, provide nameplate for each circuit breaker.
- D. Nameplates Provided by Equipment Manufacturers: All switchboards, panelboards, transformers, safety switches and the like shall be provided with engraved metal nameplates which state all industry-standard required data about the labeled equipment. Nameplates shall be affixed with screws or rivets. The use of paper nameplates only will not be accepted.

1.5 REQUESTS FOR PRIOR APPROVAL

- A. Requests for prior approval shall comply with AIA A701, Instructions to Bidders, Article 3.3.
- B. Submit requests for prior approval to Engineer no fewer than ten working days prior to bid time.
 - 1. Submit requests to gwa@gwainc.net
 - 2. Requests shall be approved in writing by Engineer.
- C. Requests for prior approval shall provide the following information:

1. Dated list of items for which approval is requested. Include project name and requesting company's name on request. For lighting fixtures, summary shall include same information required on shop drawing submittals.
 2. Identification of equipment for which approval is requested, e.g., fixture symbol, etc.
 3. Descriptive literature, catalog cuts, etc. which describe equipment or devices for which approval is requested.
- D. Approval of the A/E to use materials and/or equipment, if granted, will be in the form of a written addendum. Approved prior approvals may be used at Contractor's option. No substitutions will be allowed, nor will an increase in contract price or time be allowed (for using materials specified) if prior approvals have been requested later than ten (10) days prior to bid opening date.

1.6 SHOP DRAWINGS

- A. The Engineer will review and take appropriate action on shop drawings, product data, samples, and other submittals required by the Contract Documents. Such review shall be only for general compliance with the design and with the information given in the Contract Documents. It shall not include review of quantities, dimensions, weights, fabrication processes, construction methods, coordination with the work of other trades, or construction safety precautions, all of which are the sole responsibility of the Contractor. Engineer's review shall be conducted with reasonable promptness consistent with sound professional practice. Review of a specific item shall not indicate acceptance of an assembly of which the item is a component. The Engineer shall not be required to review and shall not be responsible for any deviations from the Contract Documents not clearly noted by the Contractor, nor shall the Engineer be required to review partial submissions or those for which submissions for correlated items have not been made.
- B. Prior to submittal of shop drawings to the Engineer, the General Contractor and the Electrical Subcontractor shall review and approve shop drawings. Shop drawings which have not been reviewed and approved in writing by the Electrical Subcontractor will not be reviewed by the Engineer. Electrical Subcontractor shall state in writing on shop drawings, any proposed deviations from contract documents. Such deviations, if not stated in shop drawings submittal, shall be the sole responsibility of the Electrical Subcontractor.

NOTE: IN ADDITION TO THE GENERAL CONTRACTOR'S APPROVAL AND STAMP, THE FIRST PAGE OF EACH SHOP DRAWING SUBMITTAL SHALL CONTAIN THE WORDS "APPROVED" OR "APPROVED AS NOTED," AND SHALL BE SIGNED, AND DATED BY THE ELECTRICAL SUBCONTRACTOR BEFORE THE ENGINEER WILL REVIEW THEM.

- C. **Lighting fixture submittal shall contain a cover sheet listing:**
1. **Project name**
 2. **All proposed fixtures by symbol, manufacturer, and catalog number**
 3. **Contractor's approval stamp and signature as noted above**
 4. **Attach lighting fixture catalog pages (cuts) to cover sheet**
- D. Electrical subcontractor shall submit for review by the Engineer detailed shop drawings of all equipment and all material listed below. **All submittal data shall be submitted at one time – partial submittals will not be reviewed by the Engineer.** No material or equipment for which Engineer's review is required shall be delivered to the job site or installed until this Contractor has in their possession the reviewed shop drawings for the particular material or equipment. The shop drawings shall be complete as described

herein. This Contractor shall submit shop drawings as directed by Architect or, if no procedure is specified by the Architect, submit one electronic .pdf copy to Engineer via email: gwa@gwainc.net.

- E. Shop drawings submitted for review shall be detailed, dimensioned drawings or catalog pages showing construction, size, arrangement, operating clearances, performance characteristics and capacity.
- F. Samples, drawings, specifications, catalogs, submitted for review shall be properly labeled indicating specific service for which material or equipment is to be used, section and article number of specifications governing, contractor's name, and project name.
- G. Catalogs, pamphlets, or other documents submitted to describe items on which review is being requested, shall be specific and identification in catalog, pamphlet, etc. of item submitted shall be clearly made in ink. Data of a general nature will not be accepted.
- H. Review rendered on shop drawings shall not be considered as a guarantee of measurements of building conditions. WHERE DRAWINGS ARE REVIEWED, SAID REVIEW DOES NOT MEAN THAT DRAWINGS HAVE BEEN CHECKED IN DETAIL; SAID REVIEW DOES NOT IN ANY WAY RELIEVE THIS CONTRACTOR FROM THEIR RESPONSIBILITY OR NECESSITY OF FURNISHING MATERIAL OR PERFORMING WORK AS REQUIRED BY THE CONTRACT DRAWINGS AND SPECIFICATIONS.
- I. Failure of contractor to submit shop drawings in time for review by Engineer with reasonable promptness consistent with sound professional practice shall not entitle them to an extension of contract time, and no claim for extension by reason of such default will be allowed.
- J. The Contractor shall submit shop drawings for the following materials and equipment for review by Engineer: **See "Note" in paragraph B, above.*
 - 1. Lighting fixtures, including all related components and accessories
 - 2. Panelboards
 - 3. Circuit breakers
 - 4. Safety switches
 - 5. Transformers
 - 6. TVSS/SPDs
 - 7. Emergency power system (generator, transfer equipment and all related components)
 - 8. Handholes and pullboxes
 - 9. Basic materials: wire, conduit, fittings, connectors
 - 10. Wiring devices
 - 11. Grounding system components: ground rods, fittings, ground bars

1.7 RECORD DATA

- A. Preserve one set of approved shop drawings and deliver to Owner prior to substantial completion of the work. Owner's shop drawings shall be bound in a 3-ring binder of good quality, with stiff vinyl or cloth front and back. Number of copies shall be as directed by Architect. In addition, provide one electronic copy (.pdf format) to Owner.

1.8 RECORD DRAWINGS

- A. Contractor shall maintain on the job site one complete set of drawings for this project. All changes authorized by the Engineers and/or the Owner as to the locations, sizes, etc. of equipment, conduit, fixtures, and/or other material and equipment shall be indicated in red pencil on the drawings as the work progresses. At the completion of the project, Contractor shall obtain a complete set of reproducibles of the drawings, and shall transfer all changes

to these reproducibles. The number of record prints specified by the Architect shall be delivered to the Architect. In addition, provide one electronic copy (.pdf format) to Owner.

1.9 COORDINATION WITH OTHER TRADES

- A. Coordinate with other trades to conceal electrical work and provide electrical work in correct locations for each piece of pump station or electrical equipment connected.

1.10 ELECTRICAL WORK FOR PUMP STATION EQUIPMENT

- A. Provide complete power wiring and connections for Owner's pump station equipment. This work includes all raceways, conductors, outlet and pull boxes, line voltage on-off switches where indicated and disconnecting means as indicated and required by applicable codes. Where magnetic motor starters, variable frequency drives or other controllers are furnished by others, install and wire complete; where controllers are provided already mounted on equipment, wire complete. In all cases provide power wiring through controller to load; do not reduce. Make all connections and color code per this division.
- B. Provide complete, and ready to receive control and instrumentation wiring by others, a raceway system for use with the Owner's process control and instrumentation systems.
- C. Coordinate all work with Owner, Owner's process vendors and contractors, including scheduling, connection requirements and all other requirements prior to bidding and provide all required electrical work in compliance with such schedules and requirements.

1.11 EQUIPMENT FOUNDATIONS AND MOUNTING

- A. Unless otherwise noted, set all floor and ground mounted equipment on minimum 6" high concrete pads reinforced with 6 x 6, 10/10 WWM. Epoxy dowel #4 rebar 12" on center along entire perimeter of pad as required to tie pad into base slab. Pads to be approximately 6" larger than equipment base and have 1" x 1" chamfer on all edges. Pads to have carborundum brick rubbed finish. Surface finish to be uniformly smooth.
- B. For generators, large transformers and other large or heavy equipment, provide foundation and equipment pads as directed by equipment vendor and to suit soil conditions.
- C. For utility pad-mounted transformers, provide pad in accordance with Utility's standard construction details.
- D. For transformers, provide isolating pads between equipment and foundation or structural support. Pads shall be formed by a minimum of two layers of 1/4"-5/16" thick neoprene, ribbed or waffled on both sides. Connect circuits through flexible conduit of 24" length to prevent transmission of vibration to structure or raceway system.
- E. Provide all required mounting devices, hardware, supplementary steel and other materials to mount equipment and raceway system. Mountings shall be secured to structure and seismically braced to comply with codes. Where additional structural members such as columns, beams, and the like are required to mount equipment, they shall be provided at no additional cost to the Owner.

1.12 TESTS, PERFORMANCE

- A. Upon completion of work, the system shall be free of faults, including short circuits, grounds and open circuits and loads shall be balanced across phases to obtain minimum neutral current in all feeders and branch circuits. Test systems as required in the presence of the Engineer or their representative, and operate to comply with applicable codes and contract documents.

- B. Remove all dirt and debris from interior of all electrical equipment, enclosures, device boxes, wireways, junction boxes, handholes and the like. Wipe down the exterior of all equipment and enclosures and touch up any scratches in painted surfaces with manufacturer furnished touch up paint to prevent corrosion.
- C. All costs associated with correction of deficiencies in the work shall be borne by the Contractor. Defective material and equipment shall be replaced; do not repair.
- D. All devices which must be adjusted or set to operate on a schedule (time clocks, program mechanisms, etc.) shall be set prior to substantial completion to operate on schedules directed by the Owner.
- E. All adjustable breakers shall be adjusted in field to settings determined by an engineering coordination study as required to determine appropriate settings for optimal power distribution coordination. Include in bid all required work and engineering services as required for this study and adjustment.

1.13 DEMONSTRATION

- A. Instruct owner in operation of all systems. Train Owner's maintenance personnel to adjust, operate, and maintain equipment.

1.14 WARRANTIES

- A. The Contractor Agrees:
 - 1. To correct defects in workmanship, materials, equipment, and operation of all systems for a period of one year from the date of Substantial Completion.
 - 2. To remove any item not specified or given written approval and replace it with an approved item.
 - 3. That all systems provided will safely, quietly, and efficiently operate in accordance with the design.
- B. This does not supersede manufacturer's warranties which may extend beyond one year.

1.15 CONSTRUCTION SEQUENCE

- A. The Contractor is cautioned that the project may be constructed in stages to accommodate the owner's use of the building. This contractor shall verify requirements prior to bidding and shall cooperate in all respects with other contractors and trades on the job to carry out the work with minimum disruption of both the owner's requirements and construction of the project.

1.16 DETAILS

- A. The details and sketches in the drawings are construction standards applicable to this project.
- B. The contractor shall comply with details as applicable to the work indicated and shall retain on the job site at all times, a complete set of drawings and specifications.

1.17 DEFINITIONS

- A. In this division of the specifications and accompanying drawings, the following definitions apply:

1. Provide: To purchase, pay for, transport to the job site, unpack, install and connect complete and ready for operation; to include all permits, inspections, equipment, material, labor, hardware and operations required for completion.
2. Install: To receive from another contractor, the owner or another entity and install complete and ready for operation. Unless otherwise indicated, receipt is assumed to be at the job site.
3. Furnish: To purchase, pay for and deliver to the job site for installation by others.
4. The contractor is cautioned that "furnish" and "install" require coordination with others. Such coordination shall be accomplished prior to bidding and bid amounts shall include all required labor, material and operations for completion of all items and systems specified and indicated.
5. As Indicated: As shown in drawings.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 26 05 00

UNDERGROUND ELECTRICAL WORK

PART 1 – GENERAL

1.01 SCOPE

- A. The work covered by this Section consists of providing all labor, material, equipment and performing all operations for construction of underground electrical work as shown on the plans and as described by these specifications. This work shall include coordination with utility companies, other trades, cutting, trenching, backfilling, construction of underground ductbank and raceway systems, handholes, removal and disposal of unsuitable or surplus materials and other work as required for a complete underground electrical system.
- B. All required associated work including traffic control, clearing, dewatering and clean-up is included in this scope.

1.02 RELATED REQUIREMENTS

- A. The following applies to this section with additions and modifications specified herein:
 - 1. Section 26 05 00, Electrical, General
 - 2. Section 26 20 00, Wiring Systems

1.03 REFERENCES

- A. The latest edition of the publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.
 - 1. AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)
 - a. AASHTO HB14 Highway Bridges
 - b. AASHTO M198 Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets
 - 2. AMERICAN CONCRETE INSTITUTE (ACI)
 - a. ACI 318 Building Code Requirements for Structural Concrete
 - b. SP-66 ACI Detailing Manual
 - 3. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
 - a. ANSI C2 National Electrical Safety Code
 - b. ANSI C 119.1 Electric Connectors - Sealed Insulated Underground Connector Systems Rated 600 Volts
 - c. ASNI/SSTE 77 Underground Enclosure Integrity
 - 4. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - a. ASTM C478 Precast Reinforced Concrete Manhole Sections
 - b. ASTM C857 Minimum Structural Design Loading for Underground Pre-cast Concrete Utility Structures
 - c. ASTM C858 Underground Pre-cast Concrete Utility Structures
 - d. ASTM C990 Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants

5. FEDERAL SPECIFICATIONS (FS)
 - a. FS RR-F-621 Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole

6. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
 - a. NEMA TC 2 Electrical Polyvinyl Chloride (PVC) Conduit
 - b. NEMA TC 3 Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing
 - c. NEMA TC 6 PVC and ABS Plastic Utilities Duct for Underground Installation
 - d. NEMA TC 9 Fittings for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installation
 - e. NEMA WC 8 Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

7. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
 - a. NFPA 70 National Electrical Code

8. UNDERWRITERS' LABORATORIES INC. (UL)
 - a. UL 6 Rigid Metal Conduit, Ninth Edition
 - b. UL 83 Thermoplastic-Insulated Wires and Cables, Ninth Edition
 - c. UL 467 Grounding and Bonding Equipment, Sixth Edition
 - d. UL 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors, Seventh Edition
 - e. UL 510 Insulating Tape, Sixth Edition
 - f. UL514A Metallic Outlet Boxes, Seventh Edition
 - g. UL 514B Fittings for Conduit and Outlet Boxes, Second Edition
 - h. UL 651 Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
 - i. UL 651A Schedule 40 and 80 High Density Polyethylene (HDPE) Conduit
 - j. UL 651B Continuous Length HDPE Conduit
 - k. UL 1242 Intermediate Metal Conduit, First Edition

1.04 DEFINITIONS

- A. In the text of this section, the words conduit and duct are used interchangeably and have the same meaning.

1.05 SUBMITTALS

- A. Preserve record data for the following:
 1. Handholes, pullboxes and covers
 2. Raceway, fittings, separators and miscellaneous components
 3. Warning tape

1.06 FIELD CONDITIONS

- A. Ground Water: Assume ground-water level is at grade level unless a lower water table is noted on Drawings.
- B. Prior to performing any work, Contractor shall perform a site walkthrough with Owner's Personnel (for existing sites), examine all Civil and Site plans for existing known utilities. Contractor shall contact state utility location service a minimum of three days prior to any digging, trenching or excavation work.

PART 2 – PRODUCTS

2.01 GENERAL REQUIREMENTS FOR DUCTS AND RACEWAYS

- a. Comply with ANSI C2

2.02 CONDUIT

- a. Rigid Metal Conduit: Galvanized steel. Comply with ANSI C80.1
- b. Plastic Conduit and Tubing: Type EPC-40, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B

2.03 NONMETALLIC DUCTS AND DUCT ACCESSORIES

- a. Underground Plastic Utilities Duct: NEMA TC 2, UL 651, ASTM F 512, Type EPC-40 with matching fittings complying with NEMA TC 3 by same manufacturer as the duct.
- b. Underground Plastic Utilities Duct: NEMA TC 6 & 8, ASTM F 512, UL 651A, Type HDPE with matching fittings complying with NEMA TC 9 by same manufacturer as the duct.
- c. Duct Accessories
 - i. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and size of ducts with which used, and selected to provide minimum duct spacing indicated while supporting ducts during concreting or backfilling.
 - ii. Warning Tape: Detectable underground warning tape shall be minimum 5-mil metal detectable tape, 3-inch wide, non-degradable, permanent ink, solid core and color coded in accordance with APWA Uniform Color Code.

2.04 PULL ROPE

- a. Nylon rope having a minimum tensile strength of 200 pounds/foot in each empty conduit/duct.

2.05 POWER WIRE AND CABLE

- a. Copper only.
- b. Wire and Cable Conductor Sizes: Conductor and conduit sizes indicated are for copper conductors unless otherwise noted. Wires and cables manufactured more than 12 months prior to date of delivery to the site shall not be used.

2.06 600-VOLT WIRES AND CABLES

- a. See Section 26 20 00.

2.07 600-VOLT WIRE CONNECTOR AND TERMINALS FOR USE WITH COPPER CONDUCTORS

- a. See Section 26 20 00.

2.08 TAPE

- a. UL 510, plastic insulating tape, capable of performing in a continuous temperature environment of 80 degrees C.

2.09 GROUNDING AND BONDING EQUIPMENT

- a. UL 467

2.10 HANDHOLES AND PULLBOXES

- A. Shall be heavy duty, open bottom, constructed of all polymer concrete reinforced with fiberglass and with all stainless steel hardware.
- B. Boxes installed in areas of incidental, non-deliberate light vehicular traffic shall meet the Tier 8 cover test load of 12,000# over a 10"x10" plate; those in incidental, non-deliberate heavy vehicular traffic areas shall meet the Tier 15 cover test load of 22,500# over a 10"x10" plate. Boxes indicated as Tier 22 type shall be tested to 33,750# over a 10"x20" plate.
- C. Covers shall include molded lettering indicating use as indicated on drawings or as directed by respective utility. Cover design load shall not exceed the design load of the handhole or box.
- D. Handholes and pullboxes shall be manufactured by Quazite, Highline Products, NewBasis, Armormcast or approved equal.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Coordinate layout and installation of raceway, handholes, boxes and other underground electrical system components with final arrangement of other utilities, site grading and surface features as determined in the field.
- B. Coordinate elevations of raceways, entrances into handholes, boxes and equipment with final locations and profiles of raceways, as determined by coordination with other utilities, underground obstructions and surface features. Revise locations and elevations as required to suit field conditions and to ensure that the raceway runs drain to handholes.
- C. Clear and grub vegetation to be removed, and protect vegetation. Remove and stockpile topsoil for reapplication.

3.02 INSTALLATION

- A. Electrical installations shall conform to requirements of NFPA 70 and ANSI C2, and to requirements specified herein.
- B. Backfill material shall be soil or select material that can be readily compacted. It shall not contain stones larger than 1-inch, debris, chunks of highly plastic clay or any other materials deemed unsuitable by the Engineer.

- C. Concrete: Shall be composed of fine aggregate, coarse aggregate, Portland cement, and water so proportioned and mixed as to produce a plastic, workable mixture. Fine aggregate shall be of hard, dense, durable, clean, and uncoated sand. The coarse aggregate shall be reasonably well graded from 3/16-inch to one inch. The fine and coarse aggregates shall be free from injurious amounts of dirt, vegetable matter, soft fragments or other deleterious substances. Water shall be fresh, clean, and free from salts, alkali, organic matter, and other impurities. Concrete shall have a compressive strength of 3000 psi at the age of 28 days. Slump shall not exceed 3 inches. Re-tempering of concrete shall not be permitted. Exposed, unformed concrete surfaces shall be given a smooth, wood float finish. Concrete shall be cured for a period of not less than 7 days, and concrete made with high early strength Portland cement shall be repaired by patching honeycombed or otherwise defective areas with cement mortar as directed.
- D. Flowable Fill: Shall meet the requirements of Section 210 of the South Carolina Department of Transportation 2007 Standard Specification for Highway Construction.
- E. Earthwork: Perform all required demolition, excavation, backfilling, and pavement repairs for electrical work.
- F. Maintain a minimum 12 inch separation between primary power and communication raceways. A minimum of 12 inch separation shall be maintained, whenever possible, above or below all other utilities at crossings. A minimum of 8 feet horizontal clearance shall be maintained, whenever possible, from all other utilities which parallel the electrical raceways/ductbank.
- G. Contractor shall notify Engineer prior to backfilling. Do not begin backfilling until Owner's representative has observed the work. Excavations shall be filled as soon as possible and not left open for prolonged periods. Provide safety (warning) barricades around all open trenches and holes before leaving unattended. Open trenches shall be covered with metal plates whenever grade cannot be restored the same day.
- H. Trenches shall be excavated to the required depth and width sufficient to allow for proper setting and jointing of the conduit and for thorough compaction of the backfill material under and around the conduit.
- I. When a firm foundation is not encountered at the required grade, all unstable material under the ductbank, and for a width of at least one diameter of largest ductbank conduit on each side of ductbank, shall be removed and the resulting excavation backfilled with suitable material and compacted.
- J. If rock, hard pan, or other unyielding material is encountered, the material shall be excavated to a depth a minimum of 4 inches below the bottom of the lowest conduit. The minimum trench width shall be 4 inches beyond the outside of the nearest conduit.
- K. All conduits shall be securely fastened in place during construction of the work.
- L. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
- M. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than five spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches (150 mm) between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
- N. Stagger conduit joints by rows and layers to provide a duct line having the maximum strength. During construction, protect partially completed duct lines from the entrance of debris such as

mud, sand, and dirt with suitable conduit plugs. As each section of a duct line is completed handhole to handhole draw a stiff bristle brush having the same diameter of the duct through the duct, until duct is clear of particles of earth, sand, and gravel; then immediately install end plugs.

- O. All conduits shall be plugged or capped with approved standard factory made plugs or caps to prevent seepage of soil, flowable fill, water and debris into the ductbank system during construction and/or temporary suspension of work.
- P. Provide all empty conduits with a Nylon pull rope. Leave a minimum of 36" of slack at each end of the pull.
- Q. Whenever trenches have not been properly filled, or if settlement occurs, they shall be refilled, smoothed off and finally made to conform to the surface of the ground. Backfilling shall be carefully performed and the original surface restored to original conditions to the full satisfaction of the Engineer.
- R. Installation of conduit, fittings, connections, manholes, handholes, and the like shall follow the respective utility company specifications and guidelines.
- S. Underground Conduit/Duct Without Concrete Encasement: The conduit shall be EPC-40-PVC conduit. The top of the conduit shall be not less than 30 inches below grade, and shall have a minimum slope of 3 inches in each 100 feet away from buildings and toward manholes, handholes and other necessary drainage points. Run conduit in straight lines except where a change of direction is necessary. As each conduit run is completed, draw a non-flexible testing mandrel not less than 12 inches long with a diameter 1/4 inch less than the inside diameter of the conduit through the conduit. After which, draw a stiff bristle brush through until conduit is clear of particles of earth, sand and gravel; then immediately install conduit plugs. Provide not less than 3 inches clearance from the conduit to each side of the trench. A minimum clearance of 2-1/2 inches shall be provided between adjacent conduits. Grade bottom of trench smooth; where rock, soft spots, or sharp-edged materials are encountered, excavate the bottom for an additional 3 inches, fill and tamp level with original bottom with sand or earth free from particles that would be retained on a 14-inch sieve. Provide warning tape at 12" B.F.G.
- T. Cable Pulling: Test existing duct lines with a mandrel and thoroughly swab out to remove foreign material before pulling cables. Pull cables down grade with the feed-in point at the manhole or buildings of the highest elevation. Use flexible cable feeds to convey cables through manhole opening and into duct runs. Accumulate cable slack at each manhole or junction box where space permits by training cable around the interior to form one complete loop. Maintain minimum allowable bending radii in forming such loops.
 - 1. Cable Lubricants: Use lubricants that are specifically recommended by the cable manufacturer for assisting in pulling jacketed cables. Cable lubricants shall be soapstone, graphite, or talc for rubber or plastic jacketed cables. Lubricant shall not be deleterious to the cable sheath, jacket, or outer coverings.
 - 2. Cable Pulling Tensions: Tensions shall not exceed the maximum pulling tension recommended by the cable manufacturer.
 - 3. Secondary Cable Runs in Nonmetallic Duct Conduit: Although not indicated, include an insulated copper equipment grounding conductor sized as required by the rating of the overcurrent device supplying the phase conductors, in nonmetallic duct conduit, for secondary cable runs, 600 volts and less.
- U. Cable Terminating: Protect terminations of insulated power and lighting cables from accidental contact, deterioration of coverings and moisture by providing terminating devices and materials. Install terminations of insulated power cables, cable joints, and medium voltage terminations in accordance with the manufacturer's requirements. Make terminations with

materials and methods as designated by the written instructions of the cable manufacturer and termination kit manufacturer.

1. Splices for 600-Volt Class Cables: Splice in underground systems only in accessible locations such as handholes and pullboxes, with a compression connector on the conductor and by insulating and waterproofing by one of the following methods suitable for continuous submersion in water and pass ANSI C119.1.
 - a. Provide cast-type splice insulation by means of molded casting process employing a thermosetting epoxy resin insulating material applied by a gravity poured method or by a pressure injected method. Provide component materials of the resin insulation in a packaged form ready for convenient mixing without removing from the package. Do not allow the cables to be moved until after the splicing material has completely set.
 - b. Gravity poured method shall employ materials and equipment contained in an approved commercial splicing kit which includes a mold suitable for the cables to be spliced. When the mold is in place around the joined conductors, prepare the resin mix and pour into the mold. Do not allow cables to be moved until after the splicing materials have completely set.
 - c. Provide heat shrinkable splice insulation by means of a thermoplastic adhesive sealant material which should be applied by a clean burning propane gas torch. Cables may be moved when joint is cool to the touch.

V. Grounding Systems: Shall be as indicated, and as required by NFPA 70 and ANSI C2

3.03 HANDHOLE AND PULLBOX INSTALLATION

- A. Comply with ASTM C 891 unless otherwise indicated.
- B. Set all handholes and pull boxes on gravel base, minimum 6" thick. Gravel bedding shall be No. 57 aggregate meeting requirements of AASHTO M43-88.
- C. Install units level and plumb and with orientation and depth coordinated with connecting raceways, to minimize bends and deflections required for proper entrances. Square covers with roadways, sidewalks, pavers and other site features. Covers shall be set flush with finished grade.
- D. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch finished grade.
- E. Where indicated, cast handhole cover frame integrally with handhole structure.

3.04 GENERAL

- A. This Contractor shall remove all mud and debris from handholes after completion.
- B. It is the intent of these specifications that the underground raceway system shall be waterproof.

3.05 TESTING

- A. Distribution Conductors 600-Volt Class: Perform 600-volt cable tests to verify that no short circuits or accidental grounds exist. Make tests using an instrument which applies a voltage of approximately 500 volts to provide a direct reading in resistance; minimum resistance shall be 250,000 ohms.

3.06 DOCUMENTATION

- A. Contractor shall maintain on the job site one complete set of drawings for this project. All changes authorized by the Engineers and/or the Owner as to the locations, sizes, etc. of equipment, conduit, fixtures, and/or other material and equipment shall be indicated in red pencil on the drawings as the work progresses. At the completion of the project, Contractor shall obtain a complete set of reproducible of the drawings, and shall transfer all changes to these reproducible.

END OF SECTION 26 05 43

WIRING SYSTEMS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Section 26 05 00, Electrical, General, applies to the work under this section.

1.02 SCOPE

- A. Provide interior wiring systems complete and ready for operation, as indicated, specified herein and in compliance with applicable codes and standards.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- a. Materials of like type shall be manufactured by the same company, with the exception of lighting fixtures.
- b. Panelboards, circuit breakers, safety switches, transformers, motor starters, contactors and the like: GE/ABB, Siemens-ITE, Square D, Eaton, or approved equal.
- c. Fittings, Condulets, Boxes and the like: Steel City, Thomas and Betts, O-Z Electrical Manufacturing Company, Appleton, Efcor, Crouse-Hinds, Garvin Industries, or approved equal.
- d. Conductors and Cables: Alpha Wire Company, Belden, Cerro Wire, Southwire Company, General Cable or approved equal.
- e. Cable Markers: 3M Company, E-Z Code, Brady, or approved equal.
- f. Connectors, Lugs and Terminals and the like: 3M Company, Ideal, Thomas and Betts, O-Z Electrical Manufacturing Company, or approved equal.
- g. Wiring Devices and the like: Best Specification Grade; Arrow Hart/Cooper, Hubbell, Legrand/P&S, Leviton, or approved equal.
- h. Fuses: Dual-Element type, "Fusetron" by Bussman or "Econ" by Economy or approved equal.
- i. Grounding Devices, and the like: Cadweld, Thomas and Betts, Appleton, Erico, O-Z Electrical Manufacturing Company, or approved equal.

2.02 CONDUIT AND FITTINGS

- a. Rigid Steel Conduit (Zinc-Coated): ANSI C80.1.
- b. Rigid Nonmetallic Conduit: PVC Type EPC-40 in accordance with NEMA TC2.
- c. Intermediate Metal Conduit (IMC): UL 1242, zinc-coated steel only.
- d. Electrical Metallic Tubing (EMT): ANSI C80.3.
- e. Flexible Metal Conduit: UL 1.
 - i. Liquid-Tight Flexible Metal Conduit (Steel): UL 360.

- f. Fittings for Metal Conduit, Electrical Metallic Tubing, and Flexible Metal Conduit: UL 514. All ferrous fittings shall be cadmium- or zinc-coated in accordance with UL 514.
 - i. Fittings for rigid metal conduit and IMC shall be threaded type. Split couplings are not acceptable.
 - ii. Fittings for electrical metallic tubing (EMT) shall be the compression type.
 - iii. Fittings for use in hazardous locations: UL 886
- g. Fittings for Rigid Nonmetallic Conduit: NEMA TC3.
- h. Electrical Nonmetallic Tubing (ENT): Not permitted.

2.03 OUTLET BOXES AND COVERS

- a. UL 514, cadmium- or zinc-coated if of ferrous metal.
- b. Provide outlet boxes of size and type required by NEC.
- c. Provide suitable extensions, rings or subcovers set to come flush with the finished surface in which boxes are mounted.
- d. Boxes for exposed raceway shall be threaded-hub cast metal, sizes as specified above.
- e. Outlet Boxes in Hazardous Locations: UL 886. Crouse-Hinds, Killark, Appleton, or approved equal.

2.04 CABINETS, JUNCTION BOXES, AND PULL BOXES

- a. UL 50, hot-dip zinc-coated, code gauge sheet steel, screw cover unless indicated otherwise.

2.05 WIRES AND CABLES

- a. Wires and cables shall meet the applicable requirements of NFPA 70 and UL for the type of insulation, jacket, and conductor specified or indicated. All wire and cable shall be new, with size, grade of insulation, voltage and manufacturer's name permanently imprinted on outer covering at regular intervals and delivered to the job site in complete coils and reels.
- b. Conductors: Conductors No. 10 AWG and smaller shall be solid, and those No. 8 AWG and larger shall be stranded. Unless indicated otherwise, conductor sizes shown are based on copper. All conductors shall be copper.
- c. Minimum Conductor Sizes: Minimum size for branch circuits shall be No. 12 AWG; for Class 1 remote-control and signal circuits, No. 14 AWG; and for Class 2 low-energy remote-control and signal circuits, No. 16 AWG. All 120 v. branch circuits exceeding 100' in length and all 277 v. branch circuits exceeding 250' in length shall be No. 10 AWG, minimum.
- d. Color Coding: Provide for all service, feeder, branch, control and signaling circuit conductors. Color shall be green for grounding conductors, and white for neutrals, except where neutrals of more than one system are installed in same raceway or box, the neutral of the higher-voltage system shall be white with a yellow stripe or shall be gray. The color of the ungrounded conductors in different voltage systems shall be as follows:
 - i. 120/208 volt, 3-phase: Phase A – black

- i. Phase B – red
 - ii. Phase C - blue
 - ii. 277/480 volt, 3-phase:
 - Phase A - brown
 - i. Phase B - orange
 - ii. Phase C - yellow
- e. Insulation: Unless specified or indicated otherwise, or required to be otherwise by NFPA 70, all power and lighting wires shall be 600-volt, Type THHN, THWN, or XHHW; remote-control and signal circuits shall be Type TW, THHN, TF, THWN or XHHW.
- f. Bonding Conductors: ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller; ASTM B 8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger.
- g. Nonmetallic-Sheathed Cable: Not permitted.

2.06 ELECTRICAL CONNECTIONS

- a. Comply with NEC Article 110-14.
- b. All termination devices, such as connectors, splicing devices, equipment terminals, device terminals and the like shall be rated and listed for operation at 75 degrees C.

2.07 SPLICES AND TERMINATION COMPONENTS

- a. UL 486A and UL 486B, as applicable for wire connectors, and UL 510 for insulating tapes. Connectors for wires No. 10 AWG and smaller shall be insulated pressure-type in accordance with UL 486A or UL 486C (twist-on splicing connector). Provide solderless terminal lugs on stranded conductors.
- b. Splices and/or taps for #8 and larger conductors shall be crimp type by T&B, Burndy, Oz, or approved equal; or IlSCO KUP-L-Tap®, ClearTap, or approved equal.

2.08 DEVICE PLATES

- a. Provide UL listed, one-piece device plates for outlets and fittings to suit the devices installed. Plates on unfinished walls and on fittings shall be of zinc-coated sheet steel or cast metal having round or beveled edges. Plates on finished walls be satin finish stainless steel. Screws shall be machine type with countersunk heads in a color to match the finish of the plate. The use of sectional type device plates will not be permitted. Plates installed in wet locations shall be gasketed. All plates shall be oversize type.

2.09 SWITCHES

- a. Disconnect Switches: NEMA KS1. Provide heavy duty, fusible type. General duty and non-fusible switches are not permitted.
 - i. Operating mechanisms shall be of the quick-make, quick-break type, with arc-suppressing characteristics.
 - ii. Enclosures shall be NEMA 1 indoors and NEMA 3R outdoors and in wet locations unless otherwise indicated, equipped with cover interlock and provisions for padlocking operating handle in OFF position. Safety switches shall be by the same manufacturer as panelboards.
 - iii. Safety switches used as motor disconnection means and located on load side of variable frequency drives (VFDs) shall be provided with factory mounted auxiliary contacts to allow communication of switch position to VFD.

2.10 RECEPTACLES

- A. NEMA WD1, heavy-duty, grounding type. Ratings and configurations shall be as indicated. Bodies shall be of gray thermosetting plastic supported on a metal mounting strap. Wiring terminals shall be of the screw type, side wired. Connect grounding pole to the mounting strap.
- B. Weatherproof Receptacles: In all damp or wet locations, provide in a cast metal box with a gasketed, weatherproof, cast-metal cover plate and a gasketed cap over each receptacle opening. The cap(s) shall be provided with a spring-hinged flap. Cover shall be "in use" type where required by local codes. Receptacle shall be UL listed for use in "damp location" or "wet location" to suit installation location.
- C. Ground Fault Circuit Interrupter Receptacles: UL 943 and shall be duplex type for mounting in a standard outlet box. The device shall be capable of detecting a current leak of 5 milliamperes.
- D. Install grounding type receptacles with the grounding terminal at the top.

2.11 PANELBOARDS

- A. UL 67 and UL 50. Panelboards for use as service disconnecting means shall additionally conform to UL 869. Panelboards shall be circuit breaker equipped unless indicated otherwise. Panelboards and all circuit breakers shall be fully-rated, series rating is not permitted. Design shall be such that any individual breaker can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as a means of obtaining clearances as required by UL. Where "space only" is indicated, make provisions for the future installation of a breaker sized as indicated. Directories shall be typed to indicate load served by each circuit and mounted in a holder behind transparent protective covering. Directory listing for each breaker shall list the type load served (lighting, receptacles, etc.) and location of load.
- B. Panelboard Buses: Support bus bars on bases independently of the circuit breakers. Main buses and back pans shall be designed so that breakers may be changed without machining, drilling, or tapping. Provide an isolated neutral bus in each panel for connection of circuit neutral conductors. Provide a separate ground bus marked with a green stripe along its front and bonded to the steel cabinet for connecting grounding conductors.
- C. Circuit Breakers: Fed. Spec. W-C-375 thermal magnetic type with interrupting capacity as indicated on drawings. Breaker terminals shall be UL listed as suitable for the type of conductor provided. Plug-in circuit breakers shall be provided only where indicated in drawings.
 - 1. Multi-pole Breakers: Provide common-trip type with a single operating handle. Breaker design shall be such that an overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C, respectively.
 - 2. Circuit Breaker with Ground-Fault Circuit Interrupter: UL 1053 and NFPA 70. Provide with "push-to-test" button, visible indication of tripped condition, and ability to detect a current imbalance of approximately 5 milliamperes.
 - 3. Circuit Breaker for Arc-Fault Circuit Interrupter: UL 1699 and NFPA 70. Provide "Push-to-Test" button and visual indication of tripped condition.
 - 4. Breakers Used as Switches for Light Fixtures: Breakers shall be marked "SWD" and switch-duty rated in accordance with UL 489.
 - 5. Breakers used to serve refrigeration and air conditioning compressors shall be type "HACR."
- D. Construction:

1. All panelboards shall have hinged, lockable front covers. All panelboard locks included in the project shall be keyed alike and each shall be provided with two (2) keys.
2. For surface-mount fronts, match box dimensions; for flush-mounted fronts, provide cover with overlap trim. Trims shall cover all live parts and shall have no exposed hardware.

E. Panelboards shall be rated for environmental conditions at location where installed:

1. Pump stations, lift stations, vicinity of wastewater, pool equipment or similar corrosive environments: NEMA 250, Type 4X, Stainless Steel

2.12 FUSES

- A. Provide a complete set of fuses for each fusible device provided. Time-current characteristics curves of fuses serving motors or connected in series with circuit breakers or other circuit protective devices shall be coordinated for proper operation; submit coordination data for approval. Fuses shall have a voltage rating not less than the circuit voltage.
- B. Cartridge Fuses, Current-Limiting Type (Class R): UL 198E, time-delay type. Associated fuseholders shall be Class R only.
- C. Cartridge Fuses, Current-Limiting Type (Classes J and L): UL 198C, Class J for 0 to 600 amps and Class L for 601 to 6000 amps.

2.13 TRANSFORMERS

- A. NEMA ST 20, DOE 2016 compliant, energy efficient, general-purpose, dry-type, self-cooled, ventilated. Provide nonventilated or sealed where indicated. Provide transformers in a NEMA 1 enclosure indoors and a NEMA 3R enclosure outdoors. Transformer shall have 220 degrees C insulation system with a temperature rise not exceeding 115 degrees C under full rated load in a maximum ambient of 40 degrees C. Transformer shall be capable of carrying continuously 115 percent of the nameplate kVA without exceeding the insulation rating. Transformers shall be the quiet type with an average sound level of at least 3 decibels lower than NEMA standard level for the transformer size indicated.
- B. Wiring compartment shall be front accessible and lugs shall be provided for cable sizes used. Enclosures shall be drip proof and adequately ventilated to maintain UL and NEMA temperature limits.
- C. KVA ratings shall be as scheduled in drawings.
- D. Transformers shall be three-phase, 60 Hz, two-winding type, with 480 volt Delta primary winding and 208Y/120 volt WYE secondary winding with grounded neutral. Primary windings shall be provided with taps, 2-2-1/2% FCAN and 2-2-1/2% FCBN.

2.14 GROUNDING AND BONDING EQUIPMENT

- A. UL 467.
- B. Ground rods shall be copper-encased steel, with minimum diameter of 3/4" and minimum length of 10 feet.

2.15 HAZARDOUS LOCATIONS

- A. Electrical materials, equipment, and devices for installation in hazardous locations, as defined by NFPA 70, shall be specially approved by Underwriters' Laboratories, Inc., or Factory Mutual

for the particular "Class," "Division," and "Group" of hazardous locations involved. The boundaries and classifications of hazardous locations shall be as indicated on the drawings and as defined by applicable codes.

PART 3 – EXECUTION

3.01 ELECTRICAL SERVICE SYSTEMS

- A. Provide service entrance of voltage and phase characteristics indicated.
- B. Provide the required meter sockets, cabinets, raceways, fittings, and connections to comply with power company metering requirements for the service entrance capacity and characteristics to be utilized.
- C. Coordinate with power company to determine requirements for service and metering and include in this work all provisions for compliance with these requirements.
- D. Color code service entrance conductors at transformer and as specified above.
- E. Service entrance conductors shall be as specified for feeders.
- F. Provide label on main service equipment indicating available fault current. Fault current shall be calculated using data obtained from serving utility and shall include date. Comply with NEC 110.24.

3.02 RACEWAYS

- A. Provide raceways for all conductors and cables. See drawings for raceway types approved for various locations and applications in the project.
- B. Provide flexible metal conduit for connection to rotating or vibrating equipment. In all potentially wet locations, provide waterproof flexible conduit. In no case shall length of flexible conduit exceed 3 feet. Support in accordance with NEC and as approved by Engineer.
- C. Contractor shall size pull and junction boxes. Comply with requirements for dimensions and conduit spacings as defined in the NEC Article 314.
- D. Raceways shall be continuous between outlets and enclosures. Bond raceway system as described in drawings and grounding specifications and make all connections wrench tight for electrical continuity. Connect raceways at boxes and enclosures using locknuts and bushings. Provide insulating bushings with grounding lug on all raceways one inch and larger.
- E. Install raceways generally as follows:
 - 1. Run concealed raceways in straight lines with long sweep bends and offsets.
 - 2. Where raceways turn up out of floor, curved portion shall not be visible.
 - 3. Run exposed raceways parallel and perpendicular with building lines. For exposed raceways in finished areas, strap with two-hole flat straps; do not use minerallac straps. Minerallac straps may be utilized in equipment rooms or utility areas.
 - 4. Support raceways within 3' of each outlet box, fitting, or enclosure, and at 10' intervals. Use malleable iron or stamped steel clamps for branch circuit raceways; use pipe hangers for feeder raceways. Do not hang conduit with wire, perforated strap, or nails.
 - 5. Cut all joints square, thread, ream and draw tight. Make bends and offsets with standard conduit ells or with an approved bender or hickey.
 - 6. No more than three quarter-bends equivalent in any run.

7. Cap raceway ends to prevent entrance of debris during construction. Cap with approved pennies, plastic caps or covers; do not tape.
 8. Complete raceway installation and clean thoroughly before pulling conductors.
 9. Where conduits pass through fire-rated walls and/or floors, provide a UL-listed through-penetration assembly with fire rating equal to wall or floor penetrated. Materials shall be by 3M Company or equal. Each assembly shall be specific to the penetrating device, e.g., single conduit, multiple conduits, busway, etc. and shall be specific to the wall or floor construction penetrated, e.g., concrete, gypsum board on wall studs, etc. Install assemblies in accordance with material manufacturer's instructions and UL Building Materials Directory, latest edition.
 10. Install expansion fittings with copper bonding jumpers in conduit runs which cross building expansion joints.
 11. Do not attach raceway, boxes or cables directly to roof decking. Provide mounting from building structure and maintain a minimum of 1-1/2" separation from lowest surface of roof deck.
 12. Ferrous metal raceways, cable trays, cablebus, auxiliary gutters, cable armor, boxes, cable sheathing, cabinets, metal elbows, couplings, nipples, fittings, supports, and support hardware shall be suitably protected against corrosion inside and outside (except threads at joints) by a coating of approved corrosion-resistant material (Thomas & Betts, Kopr-Shield, or equal). Where corrosion protection is necessary and the conduit is threaded in the field, the threads shall be coated with an approved electrically conductive, corrosion-resistant compound.
- F. Install pull boxes as shown in drawings and as required to pull conductors without damage to insulation. Provide pull boxes in accessible locations only, and size in accordance with NEC.
 - G. Unless otherwise indicated, underground service entrance conduits may be Schedule 40 PVC or coal-tar painted IMC or coal-tar painted GRS conduit at the contractor's option. All elbows shall be GRS type. Maintain conduit spacing in compliance with NEC.
 - H. Cover all raceways below grade and in concrete slabs with two brushed applications of a coal tar base coating conforming to MIL-C-18480. In lieu of asphalt coated conduit, Schedule 40 PVC conduit may be used for branch circuit raceways (conduits 1" and smaller), provided that grounding conductors are provided in all runs sized per NEC.
 - I. At Contractor's option, Schedule 40 PVC conduit may be used for underground feeder raceways, provided that GRS elbows and grounding conductors are provided for all runs. Exposed conduits shall be metallic as specified.
 - J. Install raceways of sizes shown in drawings and comply with Table 1 of NEC (latest edition). In case of conflict, install larger size.
 - K. Communication conductors/cables shall not be routed in the same conduit or raceway containing line voltage (120V and above) power conductors.
 - L. Provide in each empty raceway a pull cord or wire, identified with a cardboard tag as to location of equipment or outlet fed by conduit.
- 3.03 OUTLET, SWITCH, AND JUNCTION BOXES, FITTINGS
- A. Provide outlet and junction boxes as required for power, lighting, and communications systems as shown in drawings.
 - B. Boxes shall be held securely in place by being imbedded in masonry or shall be secured to a fixed structural unit such as a stud or joist.

3.04 CONDUCTORS

- A. Provide conductors in raceways as shown in drawings for service, feeders and branch circuits.
- B. Wire and cable shall be suitably protected from weather during storage and handling and shall be in good condition when installed.
- C. Do not pull conductors before completion of masonry, concrete and other trades which generate dust and debris. See raceways section, above.
- D. Conductors No. 8 and larger shall be connected to equipment by means of pressure type mechanical lugs. Where multiple conductors are connected to the same terminal each conductor shall be provided with an individual lug.
- E. Soldered splices shall be made mechanically secure before soldering.
- F. Join conductors with approved connectors, or by soldering, brazing or welding. Tape all connections or cover with approved prefabricated insulating devices to provide insulation resistance at the connection equal to that of the wire. Make splices in boxes or fittings only.
- G. All electrical connections and terminations shall be in accordance with NEC Section 110.14 requirements.
- H. Where tightening torque values are indicated on equipment or in equipment installation instructions, torque connections to achieve stated values utilizing a calibrated torque tool. Where equipment manufacturer provides an alternative method for achieving require torque values, this method may be used in lieu of torque tool.
- I. Where conductors are connected in parallel, the parallel conductor sets shall be installed in groups consisting of not more than one conductor per phase or neutral conductor to prevent current imbalance due to inductive reactance.

3.05 TRANSFORMERS

- A. Provide transformers complete and ready for operation, as indicated in drawings.
- B. Install transformers in accordance with manufacturer's guidelines and to allow for proper airflow. Coordinate orientation and location with all trades and install in accordance with NEC Article 110 requirements.
- C. Install transformers on equipment foundation as specified herein and provide neoprene vibration-isolating pads under mounting channels at four corners. Provide seismic anchoring to foundation. Connect conduits to transformer housing with flexible conduit for vibration isolation: minimum 12", but no longer than 36", and with grounding as specified across flex. Support in accordance with NEC and as approved by Engineer.
- D. Where transformers are shown trapeze or wall-mounted, provide supplementary structural steel as required to suspend or mount transformer from building structure. Paint structural steel with a specification grade, rust-preventive black paint.
- E. Provide transformer secondary grounding per NFPA 70, sized per Table 250-122.

3.06 PANELBOARDS

- A. Where shown on drawings and indicated in riser diagram, provide panelboards of the types and sizes indicated. Panelboards shall be installed with top of cabinet 72" above finished floor.
- B. Comply with NFPA-70, Section 408, for installation requirements and with other applicable sections for clearances. Lay out all equipment rooms in advance of roughing and notify Engineer immediately, in writing, if interferences are encountered or if code requirements cannot be met with equipment proposed.
- C. Provide multi-pole breakers of common-trip type to simultaneously disconnect all ungrounded conductors in multiwire branch circuits.

3.07 SAFETY SWITCHES

- A. Provide heavy duty, fusible safety switches as shown on drawings and in accordance with NEC requirements. Provide nameplates on switches as specified in Section 26 05 00. Wording shall identify the load which switch disconnects.
- B. Coordinate switch locations with all trades and install so that adequate workspace and clearance is provided to allow for safe access. Comply with NEC Article 110 requirements.
- C. For switches used as motor disconnects on load side of variable frequency drives, provide signaling cable as required from VFD to auxiliary contacts in safety switch. Connect complete.
- D. Provide fuses to match nameplate rating for equipment served. In no case shall fuse size exceed manufacturer's stated maximum overcurrent protection rating of equipment being served.

3.08 RECEPTACLES

- A. Provide receptacles for power as shown in drawings. Where indicated, verify location of receptacles with Owner prior to roughing.
- B. Install devices at locations indicated in details.
- C. Install outlets and devices plumb and level covering. Device plates shall contact finished surface all-around on all four sides.
- D. Protect devices during painting and clean-up of job. Leave devices clean and free from paint, dirt and debris.
- E. Prior to final completion, check all receptacles for shorts, opens and grounds and correct all incorrect connections. Check all GFCI and AFCI receptacles for proper function. Use receptacle tester as manufactured by Daniel Woodhead Company, General Electric, Leviton, or equal.

3.09 GROUNDING

- A. Provide grounding system to comply with NEC, as shown on drawings and as specified.
- B. Ground main service by bonding grounding conductor to steel building frame, concrete-encased electrode, main cold water pipe and three ground rods driven twelve feet apart outside building and located at least six feet away from building footings. Do not locate under paving; drive in planted areas only. Where ground rings are indicated, bond grounding conductor to ground ring.
- C. All ground system components and fittings used shall be free from paint, grease, and other poorly conducting material, and contact surfaces shall be cleaned thoroughly to ensure good metal-to-metal contact.

- D. Install bonding jumpers between all panelboards and feeder raceways connected thereto; across pull box and raceway expansion joints and across water meters located within buildings.
- E. All connections to grounding conductors shall be accessible for inspection and shall be made with solderless connectors brazed or bolted to the equipment or structure to be grounded. Unless otherwise indicated in drawings, grounding conductors within raceway system shall be installed in exposed rigid steel conduit with both conductor and conduit bonded at each end. Do not cover main service grounding until Engineer has observed connections.
- F. Provide a ground wire in all circuits sized per NEC Table 250-122 as applicable.
- G. Provide in all runs of flexible conduit a separate grounding conductor sized per NEC Table 250-122.

END OF SECTION 26 20 00

EMERGENCY POWER SYSTEM

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. The following apply to the work under this Section:
 - 1. Section 26 05 00, Electrical, General
 - 2. Section 26 20 00, Wiring Systems

1.02 SCOPE

- A. Provide, complete and ready for operation, an emergency power system consisting of diesel-electric engine generator set, unit-mounted radiator, silencer, emergency power off switch fuel storage/supply system, automatic transfer switch, line circuit breaker, controls, electrical distribution, piping and all other accessories, supplies, foundation, labor and materials required for a complete system.
- B. The entire system including fuel storage, but excluding automatic transfer switch, shall be mounted inside a sound attenuated weatherproof housing and on a single, steel skid base. Entire unit shall be factory assembled, tested, shipped and lifted onto a job-furnished concrete mounting slab, sized to suit equipment furnished. Individual components brought to and assembled on the job site will not be accepted.
- C. The system shall be as manufactured by Caterpillar, MTU-Online, Cummins-Onan, Kohler or approved equal. Equipment shall be furnished by a dealer with service facilities and spare parts stock, as approved by Engineer, within two hours time of the job site by normal ground transportation. In addition, the dealer shall be able to demonstrate, in the judgment of the Engineer, adequate experience in the installation/service of standby power equipment of equivalent size and type specified herein. Dealer shall also demonstrate, to the satisfaction of the Engineer, successful installation and operation of at least two installations of packaged emergency power plants.
- D. All emergency transfer equipment/switchgear specified in other sections shall be supplied by the generator set manufacturer in order to establish and maintain a single source of system responsibility and coordination.

1.03 GENERAL

- A. Materials and Workmanship: All materials, equipment and parts comprising the unit specified herein shall be new and unused, of current manufacture, and of highest grade.
- B. Warranty: Equipment furnished under this section shall be guaranteed against defective parts or workmanship under terms of the manufacturer's and dealers standard warranty, for a period of two (2) years from acceptance by the Owner.
- C. Tests: The generator set shall receive the manufacturer's standard factory load testing. Prior to acceptance of the installation, equipment shall be tested to show it is free of any defects and will start and be subjected to full load test.
- D. Start-up and Instructions: On completion of installation, start-up shall be performed by a factory-trained dealer service representative. Operating and maintenance instruction books shall be supplied upon delivery to the unit and procedures explained to operating personnel.
- E. Specifications and Drawings: Prior to bidding, bidders shall furnish information showing manufacturer's model numbers, dimensions and operating data for the generator set, radiator,

silencer, transfer switch and major equipment. The successful bidder shall submit copies of pertinent drawings and wiring diagrams for approval prior to manufacture and assembly.

1.04 QUALITY ASSURANCE AND CODE CRITERIA

- A. Manufacturer Qualifications: Maintain a service center capable of emergency maintenance and repairs at the project within two hours maximum response time (100 miles of the project site). The manufacturers' distribution responsible for the project territory will only be allowed to supply the product in order to provide Owner with local future service. Distributors outside of the project territory will not be allowed to provide product. The supplier must carry sufficient inventory to cover no less than 80% parts service within 24 hours and 95% within 48 hours.
- B. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70-2020 Article 100, by a testing agency acceptable to authorities having jurisdiction.
- C. The generator set covered by these specifications shall be designed, tested, rated, assembled and installed in strict accordance with all applicable standards, including, but not limited to:
 - 1. NFPA 70 (National Electrical Code)
 - 2. NFPA 99
 - 3. NFPA 110
 - 4. CSA 100
 - 5. CSA C22.2 No14
 - 6. CSA 282
 - 7. EN61000-6
 - 8. EN55011
 - 9. FCC Part 15 Subpart B
 - 10. ISO8528
 - 11. IEC61000
 - 12. UL508
 - 13. UL2200
 - 14. UL142
- D. Comply with NFPA 110 requirements for Level 1 emergency power supply system.
- E. Engine Exhaust Emissions: Comply with applicable state and local government requirements. Actual engine emissions values shall be in compliance with applicable EPA emissions standards per ISO 8178 – D2 Emissions Cycle at specified eKW/bHP rating. Utilization of the "Transition Program for Equipment Manufacturers" (also known as "Flex Credits") to achieve EPA certification is not acceptable. Emissions requirements/certifications of this package: EPA T2.

PART 2 - PRODUCTS

2.01 GENERATOR SET CHARACTERISTICS

- a. Rating at 1800 RPM Section 2.1:
 - i. Standby capacity without Fan: as indicated on drawings
 - ii. Power Factor: 0.8
 - iii. Frequency: 60 Hertz
- b. The specified standby capacity shall be for continuous electrical service during interruption of the normal utility source.

- c. These ratings must be substantiated by manufacturer's standard published curves. Special ratings or maximum ratings are not acceptable.
- d. Voltage: The generator output voltage shall be 277/480 volts, 3-phase, 4-wires.

2.02 GENERAL

- a. Safety Standard: Comply with ASME B15.1.
- b. Resistance to Seismic Forces: Supports for internal and external components, and fastenings for batteries, wiring, and piping are designed and constructed to withstand static or anticipated seismic forces, or both in any direction.
- c. Skid: Adequate strength and rigidity to maintain alignment of mounted components without depending on a concrete foundation.
- d. Space Heater: Provide a generator mounted space heater, 208 or 480 VAC to suit site conditions, and single phase. Space heater shall be thermostatically controlled and shall be disconnected when engine is running.
- e. The generator set shall be mounted on steel spring type vibration isolators rated for International Building Code (IBC) seismic requirements. Anchor generator to concrete pad.

2.03 ENGINE

- a. Type: The engine shall be water-cooled, in-line or Vee-type, four-stroke cycle compression ignition diesel. It shall meet specifications when operating on No. 2 domestic burner oil. Diesel engines requiring premium fuels will not be considered. The engine shall be equipped with lube oil and intake air filters; lube oil coolers, fuel transfer pump, fuel priming pump, and gear-driven water pump.
- b. The engine governor shall be the electronic type and shall maintain frequency regulation not to exceed 3% (1.8 Hertz) from non load to full rated load.
- c. Mounting: The unit shall be mounted on a structural steel sub-base and shall be provided with suitable vibration isolators.
- d. Safety Devices: Safety shut-offs for high water temperature, low oil pressure, overspeed, and engine overcrank shall be provided.
- e. Start Time: Comply with NFPA 110, Type 1 system requirements

2.04 GENERATOR

- a. Type: The generator shall be a 12-lead, re-connectable, three-phase, 60 Hertz, single bearing, synchronous type built to NEMA standards. Class F insulation shall be used on the stator and rotor, and both shall be further protected with 100% epoxy impregnation and an overcoat of resilient insulation material to reduce possible fungus and/or abrasion deterioration. Generator shall incorporate reactive droop compensation.
- b. Regulator: A generator-mounted, volts-per-Hertz type regulator shall be provided to match the characteristics of the generator and engine. Voltage regulation shall be plus or minus 2 percent from no load to full rated load. Readily accessible voltage droop, voltage level and voltage gain controls shall be provided. Voltage level adjustment shall be a minimum of plus or minus 5

percent. The solid state regulator module shall be shock-mounted and epoxy-encapsulated for protection against vibration and atmospheric deterioration.

- c. Excitation: Generator shall utilize (AREP) Permanent Magnet (PMG) method of excitation.
- d. Steady State Voltage Operational Bandwidth: Four percent of rated output voltage from no load to full load.
- e. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
- f. Transient Frequency Performance: Less than 5 percent variation for a 50 percent step-load increase or decrease. Frequency recovers to remain within the steady-state operating band within five seconds.
- g. Output Waveform: At no load, harmonic content measured line to line to neutral does not exceed 5 percent total and 3 percent for single harmonics. The telephone influence factor, determined according to NEMA MG 1, shall not exceed 50.
- h. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, the system will supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to any generator system component.
- i. Load Sensitivity: The generator and its controls shall be capable of handling any connected VFD or UPS loads.
- j. The generator winding shall be form wound. The winding shall have an intake filter that is easily removable and cleanable on the intake end.

2.05 COOLING SYSTEM

- a. Radiator: A unit-mounted radiator with blower type fan shall be sized to maintain safe operation at 110 degrees F maximum ambient temperature without derating the unit.
- b. Antifreeze: The engine cooling system shall be filled with a solution of 50 percent ethylene glycol.

2.06 FUEL SYSTEM

- a. Fuel Storage Tank: Provide manufacturer's standard UL 142, double wall fuel storage tank mounted integrally with steel base, with vents, gauges, and valves. Provide locking filler cap on fill pipe. Fuel will be furnished by the Owner. Tank capacity shall be sufficient for 48 hours' operation at full load.
- b. An engine-mounted fuel filter, fuel pressure gauge, and engine fuel piping priming pump shall be provided.

2.07 EXHAUST SYSTEM

- a. Exhaust Silencer: Provide a critical type silencer including flexible exhaust fitting for unit mounting, properly sized and installed according to the manufacturer's recommendations. Silencer shall be mounted so that its weight is not supported by the engine. Exhaust pipe size shall be sufficient to ensure that measured exhaust back pressure does not exceed the

maximum limitations specified by the generator set manufacturer. Silencer shall be mounted on top of weatherproof housing.

2.08 AUTOMATIC STARTING SYSTEM

- a. Starting Motor: Provide a 12-volt dual DC electric starting system with positive engagement drive. Starting system shall incorporate an automatically reset circuit breaker for antibutt engagement.
- b. Automatic Controls: Fully automatic generator set start-stop controls in the generator control panel shall be provided. Controls shall provide shutdown for low oil pressure, high water temperature, overspeed, overcrank, and one auxiliary contact for activating accessory items. Controls shall include a 30-second single cranking cycle limit with lockout.
- c. Jacket Water Heater: A unit-mounted thermal circulation type water heater shall be furnished to maintain engine jacket water to 90 degrees F in an ambient temperature of 30 degrees F.
- d. Batteries: A 12-volt lead-acid storage battery set of the heavy-duty diesel starting type shall be provided. The battery set shall be of sufficient capacity to provide for one and one-half minutes total cranking time without recharging and will be rated no less than 170 amp-hours. A battery rack and necessary cables and clamps shall be provided. Comply with NFPA 70, Article 480.
- e. Battery Charger: A current-limiting battery charger shall be furnished to automatically recharge batteries. Charger shall float at 2.17 volts per cell and equalize at 2.33 volts per cell. It shall include overload protection, silicon diode full wave rectifiers, voltage surge suppressors, DC ammeter and voltmeter, and fused AC input. AC input voltage shall be 120 volts. Current output shall be not less than 10 amperes.

2.09 GENERATOR CONTROL PANEL

- a. Type: A generator-mounted NEMA 1 type, vibration isolated, dead front, 14-gauge steel control panel shall be provided.
- b. Equipment: Panel shall contain, but not be limited to, the following equipment:
 - i. Voltmeter, 3-1/2 inch, 2 percent accuracy
 - ii. Ammeter, 3-1/2 inch, 2 percent accuracy
 - iii. Ammeter phase selector switch
 - iv. Frequency meter, 3-1/2 inch, dial type
 - v. Automatic starting controls as specified
 - vi. Panel illumination lights and switch
 - vii. Voltage level adjustment rheostat
 - viii. Engine oil pressure gauge
 - ix. Engine water temperature gauge
 1. Dry contacts for remote alarms wired to terminal strips
 2. Fault indicators for low oil pressure, high water temperature, overspeed and overcrank
 3. Four position function switch marked "auto," "manual," "off/reset," and "stop"
- B. In lieu of individual equipment, manufacturer may provide standard digital control panel incorporating functions indicated.

2.10 MAIN LINE CIRCUIT BREAKER

- A. Type: A generator-mounted main line molded case circuit breaker shall be provided as a load circuit interrupting and protection device. It shall operate both manually for normal switching function and automatically during overload and short circuit conditions.
- B. The trip unit for each pole shall have elements providing inverse time delay during overload conditions and instantaneous magnetic tripping for short circuit protection. The circuit breaker shall meet standards established by Underwriters' Laboratories, National Electric Manufacturer's Association, and National Electrical Code.
- C. Generator exciter field circuit breakers will not be accepted for line protection.

2.11 AUTOMATIC TRANSFER SWITCH

- A. The automatic transfer switch shall be supplied by the manufacturer of the engine-generator set. It shall be listed by Underwriters' Laboratories Standard 1008. The manufacturer shall furnish schematic and wiring diagrams for the automatic transfer switch and a typical interconnection wiring diagram for the entire standby system.
- B. The automatic transfer switch shall be rated as indicated and wall mounted in a NEMA 1 enclosure. The transfer switch shall have, but not be limited to, the following characteristics.
 - 1. Four-position cranking selector: Auto, Hand, Test, Off.
 - 2. Time delay on start variable to 120 seconds.
 - 3. Time delay on shut down variable to 10 minutes.
 - 4. Time delay on re-transfer variable to 10 minutes.
 - 5. Auxiliary contacts: four.
 - 6. Battery charge - two-rate ambient temperature compensated.
 - 7. Normal and emergency line indicators.
 - 8. Cabinet locks.
 - 9. Exerciser: Field settable, to exercise plant on a once-per-week or other schedule, as directed by Owner; adjustable 30 to 50 minutes running time under load.

2.12 REMOTE ANNUNCIATOR PANEL

- A. Provide manufacturer's standard (NFPA 99/110, CSA 282) remote annunciator panel with visual and audible signals. This panel shall annunciate, at a minimum, the following:
 - 1. Generator supplying load (emergency power)
 - 2. Utility supplying load (normal power)
 - 3. Low oil pressure
 - 4. Low water temperature
 - 5. High water temperature
 - 6. Low fuel alarm
 - 7. Overcrank
 - 8. Overspeed
 - 9. Battery charger malfunction
- B. Switches shall be provided for lamp test and alarm silence.

2.13 EMERGENCY POWER OFF (EPO)

- A. Provide emergency power off device to comply with NFPA 110, Level 1 Installations.

2.14 SOUND-ATTENUATED WEATHER PROOF HOUSING

- A. Provide Level II sound-attenuated, weatherproof enclosure as part of integrated package with generator set, exhaust system and fuel tank. System shall be factory assembled on steel base.
- B. Enclosure shall be of steel construction, minimum 14 gauge.
- C. Doors and access panels shall be lockable and shall be located to allow easy access to all major generator and engine control components. Enclosure shall be NEC and NFPA compliant and provided with required working clearances around electrical equipment.
- D. Air inlet and outlet louvers shall be provided in accordance with generator set manufacturer requirements.
- E. Provide primed and powder coated finish. Color shall be as directed by architect from manufacturer's standard color selection.
- F. Weatherproof enclosure shall be provided with one GFCI 5-20R weather-resistant receptacle and a minimum of two LED lights, wired to an internally mounted switch located adjacent to service door opening.
- G. A 120/208V, single-phase, minimum 60A load center shall be provided inside weatherproof enclosure to power generator auxiliaries, included, but not limited to: battery charger, heater(s), GFCI convenience receptacle and interior lighting. The load center shall be factory wired to all generator related components, and ready to receive contractor furnished feeder from the building's electrical system.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Contractor shall lay out all work in advance of construction. Coordinate all field measurements for conduit entry points, piping connections, and auxiliaries and accessories prior to laying out work.
- B. All work shall be neatly arranged and executed in a workmanlike manner.
- C. Provide and install equipment on concrete foundation suitable to support weight of equipment, including all liquids and accessories. Foundation construction, thickness, dimensions and reinforcing shall be in accordance with manufacturer's guidelines and as appropriate for soil conditions at installation location. Foundation shall be level, flat and include provisions for seismic mounting of equipment furnished.
- D. Coordinate with all trades to avoid conflict with the Owner's use of the building and grounds and provide at least 72 hours notice to the Owner prior to running of the engine.
- E. Provide all cutting and patching of the building and the site in accordance with Section 26 05 00 of these specifications.
- F. Make all connections for power, control, fuel and water as required for a complete system, including all plant auxiliaries.
- G. Connect factory-provided auxiliary power load center complete to power source in accordance with manufacturer instructions and NFPA 110 requirements. Include all required raceway, conductors, circuit breakers and associated work. Power source shall be clearly identified in building and at load center utilizing a permanently affixed nameplate indicating serving panelboard, circuit designation and location of panelboard.

3.02 FUEL

- A. Provide all fuel as required for startup, testing and training.
- B. Upon completion of startup, testing and training, Contractor shall fill tank with fuel to rated capacity.

3.03 START-UP

- A. A factory-trained technician, in the full-time employ of the engine generator supplier, shall be present at initial start-up of the emergency system and operational tests shall be performed at that time. The Engineer and/or Architect reserve the right to be present during such tests. Prior to start-up, the engine generator supplier shall furnish the necessary engine oil and antifreeze and make all adjustments necessary to make the entire system operational. In addition to start-up, the generator representative shall instruct the Owner's operating personnel in proper operation and care of the unit, along with supplying complete operating and maintenance manuals.
- B. After installation is complete and normal power is available, a factory approved technician shall perform a four (4) hour loadbank test at 1.0 power factor at full nameplate rating. Include loadbank, cabling and all associated equipment and work as required for this test.
- C. An Integrated Systems Test will be performed prior to turning facility over to Owner. Include in bid the presence of a factory-trained technician to assist in test, make adjustments to settings/programming and to take immediate corrective action for any deficiencies discovered during testing.

3.04 TRAINING

- A. Provide a minimum of four (4) hours on-site training of Owner's personnel in the proper operation and maintenance of the equipment. Review operation and maintenance manuals, parts manuals, service and testing procedures and emergency service procedure.

END OF SECTION 26 32 13

STRUCTURED CABLING RACEWAY

PART 1- GENERAL

1.01 RELATED DOCUMENTS

- A. The following apply to the work under this section.
 - 1. Section 26 05 00, Electrical, General
 - 2. Section 26 20 00, Wiring Systems

1.02 SCOPE

- A. Provide, complete and ready to receive wires and cables, a raceway system for use with the Owner's communication systems, including:
 - 1. SCADA System
 - 2. Telemetry System
- B. The system shall include, but not be limited to, raceways, cable management systems, junction boxes, outlet boxes, devices and other accessories for Owner's systems.
- C. Coordinate all work with Owner, utility companies, and Owner's communications contractor for schedule, connection requirements (including service points) and all other requirements prior to bidding and provide all required electrical work in compliance with such schedules and requirements.
- D. When installing raceways avoid sharp bends and provide conduit work as recommended for best performance under conditions of use. Use only long conduit sweeps and long bends in conduit installation. Obtain cable installation requirements for system vendors, Owner and utilities prior to installation and comply.
- E. Leave pull wires (#10 AWG) or ropes (200-pound test nylon) in all empty conduits, identified with a cardboard tag as to location of outlet served by conduit.

PART 2 - PRODUCTS

2.01 STRUCTURED CABLING SYSTEM

- A. Conduit Sizing: Unless otherwise indicated, conduit shall be a minimum of 3/4". Size conduits for risers to plywoods, cabinets, junction boxes, distribution centers, and service as indicated.
- B. Terminal Cabinets: Construct of cold-rolled sheet steel. Match trim, hardware, doors, and finishes to panelboards.
- C. Grounding and Bonding Equipment:
 - 1. UL 467.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Strap all conduits and provide bushings on all conduits.

- B. Provide a ground wire of AWG # 6 size in rigid conduit, from service entrance grounding conductor. Bond conduit and wire at both ends. Connect complete to ground busbar at each cabinet.
- C. Raceways, boxes, fittings and cabinets shall be as specified in Section 26 20 00.

END OF SECTION 27 05 00

SECTION 31 00 00

EARTHWORK

PART 1 GENERAL

1.01 SCOPE

- A. This Section includes earthwork and related operations, including, but not limited to dewatering, excavating all classes of material encountered, pumping, draining and handling of water encountered in the excavations, handling, storage, transportation and disposal of all excavated and unsuitable material, construction of fills and embankments, backfilling around structures, compacting, all sheeting, shoring and bracing, preparation of subgrades, surfacing and grading and any other similar, incidental or appurtenant earthwork operations which may be necessary to properly complete the work.
- B. The Contractor shall provide all services, labor, materials and equipment required for all earthwork and related operations, necessary or convenient to the Contractor, for furnishing complete work as shown on the Drawings or specified in these Contract Documents.

1.02 RELATED SECTIONS

- A. Section 00 21 13 – Instructions to Bidders
- B. Section 01 45 29 – Testing Laboratory Services
- C. Section 31 10 00 - Site Preparation
- D. Section 31 22 00 – Grading
- E. Section 31 22 16 - Excavation
- E. Section 31 25 00 - Erosion and Sedimentation Control

1.03 GENERAL

- A. The elevations shown on the Drawings as existing are taken from the best existing data and are intended to give reasonably accurate information about the existing elevations. They are not precise and the Contractor shall become satisfied as to the exact quantities of excavation and fill required.
- B. Earthwork operations shall be performed in a safe and proper manner with appropriate precautions being taken against all hazards.
- C. All excavated and filled areas for structures, trenches, fills, topsoil areas, embankments and channels shall be maintained by the Contractor in good condition at all times until final acceptance by the Owner. All damage caused by erosion or other construction operations shall be repaired by the Contractor using material of the same type as the damaged material.
- D. The Contractor shall control grading in a manner to prevent surface water from running into excavations. Obstruction of surface drainage shall be avoided and means shall be provided whereby storm water can be uninterrupted in existing gutters, other surface drains, or temporary drains. Free access must be provided to all fire hydrants and meters.
- E. Tests for compaction and density shall be conducted by an independent testing laboratory selected in accordance with Section 01 45 29 of these Specifications.

1. The soils testing laboratory is responsible for the following:
 - a. Field compaction testing shall be based on using the maximum dry density determined by the Standard Proctor Compaction Test in accordance with ASTM D 698.
 - b. Determination of in-place backfill density shall be done in accordance with ASTM D 1556, "Density and unit weight of Soil In Place by the Sand-Cone Method", ASTM D 2937, "Density of Soil In Place by the Drive-Cylinder Method" or ASTM D 2922, "Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)".
 - c. Field density tests for each lift; one test for each 5,000 square feet of fill or minimum one test per lift.
 - d. Inspecting and testing stripped site, subgrades and proposed fill materials.
2. Contractor's duties relative to testing include:
 - a. Notifying laboratory of conditions requiring testing.
 - b. Coordinating with laboratory for field testing.
 - c. Providing representative fill soil samples to the laboratory for test purposes. Provide 50 pound samples of each fill soil.
3. Inspection
 - a. Earthwork operations, suitability of excavated materials for fill and backfill and placing and compaction of fill and backfill is subject to inspection. Engineer will observe earthwork operations.
 - b. Foundations and shallow spread footing foundations are required to be inspected by an engineer to verify suitable bearing and construction.
- F. All earthwork operations shall comply with the requirements of OSHA Construction Standards, Part 1926, Subpart P, Excavations, Trenching and Shoring and Subpart O, Motor Vehicles, Mechanized Equipment and Marine Operations and shall be conducted in a manner acceptable to the Engineer.
- G. It is understood and agreed that the Contractor has made a thorough investigation of the surface and subsurface conditions of the site and any special construction problems which might arise as a result of nearby watercourses and floodplains. The Contractor shall be responsible for providing all services, labor, equipment and materials necessary or convenient to the Contractor for completing the work within the time specified in these Contract Documents.
- H. Safety

Perform all trench excavation and backfilling activities in accordance with the Occupational Safety and Health Act of 1970 (PL 91-596), as amended. The Contractor shall pay particular attention to the Safety and Health Regulations Part 1926, Subpart P "Excavation, Trenching & Shoring" as described in OSHA publication 2226.

PART 2 PRODUCTS

2.01 SOILS CLASSIFICATIONS

Bedding materials listed here include a number of processed materials plus the soil types defined according to the Unified Soil Classification System (USCS) in ASTM D 2487, Standard Method for Classification of Soils for Engineering Purposes. (See below for description of soil classification). These materials are grouped into five broad categories according to their suitability for this application:

- A. Class I - Angular, 1/4 to 1 1/2 inches (6 to 40 mm) graded stone, including such as coral, slag, cinders, crushed shells and crushed stone. Note - The size range and resulting high voids ratio of Class I material make it suitable for use to dewater trenches during pipe installation. This permeable characteristic dictates that its use be limited to locations where pipe support will not be lost by migration of other embedment materials into the Class I material. When such migration is possible, the material's minimum size range should be reduced to finer than 1/4 inch (6 mm) and the gradation properly designed to limit the size of the voids.
- B. Class II - Coarse sands and gravels with maximum particle size of 1 1/2 inch (40 mm), including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil Types GW, GP, SW and SP are included in this class. Note - Sands and gravels which are clean or borderline between clean and with fines should be included. Coarse-grained soils with less than 12% but more than 5% fines are neglected in ASTM D2487 and the USCS and should be included. The gradation of Class II material influences its density and pipe support strength when loosely placed. The gradation of Class II material may be critical to the pipe support and stability of the foundation and embedment if the material is imported and is not native to the trench excavation. A gradation other than well graded, such as uniformly graded or gap graded, may permit loss of support by migration into void spaces of a finer grained natural material from the trench wall and foundation.
- C. Class III - Fine sand and clayey (clay filled) gravels, including fine sands, sand-clay mixtures and gravel-clay mixtures. Soil Types SM, GC, SM and SC are included in this class.
- D. Class IV - Silt, silty clays and clays, including inorganic clays and silts of not to high plasticity and liquid limits. Soil Types MH, ML, CH and CL are included in this class. Note- Caution should be used in the design and selection of the degree and method of compaction for Class IV soils because of the difficulty in properly controlling the moisture content under field conditions. Some Class IV soils with medium to high plasticity and with liquid limits greater than 50% (CH, MH, CH-MH) exhibit reduced strength when wet and should only be used for bedding, haunching and initial backfill in arid locations where the pipe embedment will not be saturated by ground water, rainfall and/or exfiltration from the pipeline system. Class IV soils with low to medium plasticity and with liquid limits lower than 50% (CL, ML, CL-ML) also require careful consideration in design and installation to control moisture content but need not be restricted in use to arid locations.
- E. Class V - This class includes the organic soils OL, OH and PT as well as soils containing frozen earth, debris, rocks larger than 1 1/2 inch (40 mm) in diameter and other foreign materials. These materials are not recommended for bedding, haunching or initial backfill.

DESCRIPTION OF EMBEDMENT MATERIAL CLASSIFICATIONS

SOIL CLASS	SOIL TYPE	DESCRIPTION MATERIAL CLASSIFICATION
Class I Soils *	---	Manufactured angular, granular material, 3/4 to 1-1/2 inches (6 to 40 mm) size, including materials having regional significance such as crushed stone, or rock, broken coral, crushed slag, cinders, or crushed shells.
Class II Soil **	GW	Well-graded gravels and gravel-sand mixtures, little or no fines. 50% or more retained on No. 4 sieve. More than 95% retained on No. 200 sieve. Clean.
	GP	Poorly graded gravels and gravel-sand mixtures, little or no fines. 50% or more retained on No. 4 sieve. More than 95% retained on No. 200 sieve. Clean
	SW	Well-graded sands and gravelly sands, little or no fines. More than 50% passes No. 4 sieve. More than 95% retained on No. 200 sieve. Clean.
	SP	Poorly graded sands and gravelly sand, little or no fines. More than 50% passes No. 4 sieve. More than 95% retained on No. 200 sieve. Clean.
Class III Soil ***	GM	Silty gravels, gravel-sand-silt mixtures. 50% or more retained on No. 200 sieve.
	GC	Clayey gravels, gravel-sand-clay mixtures. 50% or more retained on No. 4 sieve. More than 50% retained on No. 200 sieve.
	SM	Silty sands, sand-silt mixtures. More than 50% passes No. 4 sieve. More than 50% retained on No. 200 sieve.
	SC	Clayey sands, sand-clay mixtures. More than 50% passes No. 4 sieve. More than 50% retained on No. 200 sieve.
Class IV Soils	ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands. Liquid limit 50% or less. 50% or more passes No. 200 sieve.
	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. Liquid limit 50% or less. 50% or more passes No. 200 sieve.
	MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts. Liquid limit greater than 50%. 50% or more passes No. 200 sieve.
	CH	Inorganic clays of high plasticity, fat clays. Liquid limit greater than 50%. 50% or more passes No. 200 sieve.
Class V Soils	OL	Organic silts and organic silty clays of low plasticity. Liquid limit 50% or less. 50% or less. 50% or more passes No. 200 sieve.
	OH	Organic clays of medium to high plasticity. Liquid limit 50% or less. 50% or more passes No. 200 sieve.
	PT	Peat, muck and other highly organic soils.

- * Soils defined as Class I materials are not defined in ASTM D2487.
- ** In accordance with ASTM D2487, less than 5% pass No. 200 sieve.
- *** In accordance with ASTM D2487, more than 12% pass No. 200 sieve. Soils with 5% to 12% pass No. 200 sieve fall in borderline classification, e.g. GP-GC.

2.02 FILL MATERIAL

- A. Sand Fill: Material shall consist of a clean sand with a fineness modulus of 1.6 to 3.1 and containing not more than 10 percent by weight finer than No. 200 U.S. Standard Sieve.
- B. Earth Fill: Material shall consist of inorganic material free of roots, cobbles and boulders and classified as SM, ML, SC, or CL by ASTM D2487-85 "Standard Methods for Classification of Soils for Engineering Purposes". Earth Fill shall also conform to the following:
 - 1. Liquid Limit = 50 maximum
 - 2. Plasticity Index = 20 maximum
 - 3. Dry Unit Weight = 90 pcf minimum maximum density

2.03 UNSUITABLE SITE FILL MATERIAL

- A. Material which does not conform to the above classifications (soil classification SP, SW.GM, CH, MH, OH, OL and PT) may be used as Site Fill material in areas identified on the drawings as "spoil areas", in areas with no structures and or roads and other non-critical areas.

2.04 SHEETING, BRACING AND TIMBERING

- A. Sheeting, Bracing and Timbering: The Contractor shall furnish, place and maintain all sheeting, bracing and timbering required to properly support trenches and other excavations in open cut and to prevent all movement of the soil, pavement, structures, or utilities outside of the trench or pit.
 - 1. General
 - a. Cofferdams and bracing design, including computations, shall be prepared before commencing construction operations. Drawings and design computations shall be signed and sealed by a professional engineer registered in the State of South Carolina. The drawings and design computations shall be submitted to the Engineer for informational purposes only.
 - b. Sheeting, bracing and timbering shall be so placed as to allow the work to be constructed to the lines and grades shown on the Drawings and as ordered by the Engineer.
 - c. If at any time the method being used by the Contractor for supporting any material or structure in or adjacent to any excavation is not reasonably safe, the Contractor shall provide additional bracing and support necessary to furnish the added degree of safety.
 - d. All sheeting in contact with the concrete or masonry shall be cut off as directed by the Engineer and left in place.
 - 2. Timber: Timber may be substituted for steel sheet piling when approved by the Engineer. Timber for shoring, sheeting or bracing shall be sound and free of large or loose knots and in good condition. Size and spacing shall be in accordance with OSHA regulations.

3. Steel Sheet Piling: Steel sheet piling shall be the continuous interlock type. The weight, depth and section modulus of the sheet piling shall be sufficient to restrain the loads of earth pressure and surcharge from existing foundations and/or live loads. Procedure for installation and bracing shall be so scheduled and coordinated with the removal of the earth that the ground under existing structures shall be protected against lateral movement at all times. The Contractor shall provide closure and sealing between sheet piling and existing facilities. Steel piling shall be removed, unless otherwise directed by the Engineer.
4. Remove bracing and sheeting in units when backfill reaches the point necessary to protect the structures and adjacent property. Leave sheeting in place when, in the opinion of the Engineer, it cannot be safely removed. Cut off sheeting left in place at least two feet below the surface.

2.05 FILTER FABRIC

- A. Filter fabric associated with bedding shall be a UV stabilized, spunbonded, continuous filament, needle punched, polypropylene, nonwoven geotextile.
- B. The fabric shall have an equivalent open size (EOS or AOS) of 120 - 70. The fabric shall also conform to the minimum property values listed in the following table:

Fabric Property	Unit	Test Procedure	Average Value	
			Typical	Minimum
Weight	oz/yd ²	ASTM D 3776	8.3	
Thickness	mils	ASTM D 1777	105	
Grab Strength	lbs.	ASTM D 4632	240	210
Grab Elongation	%	ASTM D 4632	>50	50
Tear Strength	lbs.	ASTM D 4533	100	85
Mullen Burst	psi	ASTM D 3786	350	320
Puncture Resistance	lbs.	ASTM D 4833	115	100
Permittivity	sec ⁻¹	ASTM D 4491	1.7	
Water Permeability	cm/sec	ASTM D 4491	0.4	
Water Flow Rate	gpm/ft ²	ASTM D 4491	120	
UV Resistance (500 hrs)	%	ASTM D 4355	>85	
PH			2 – 13	

- C. Filter fabric shall be Polyfelt TS 700, Trevira 1125, SuPac 7-MP or approved equal.

2.06 CONCRETE

Concrete for initial backfill or encasement shall have a compressive strength of not less than 3,000 psi, with not less than 5.5 bags of cement per cubic yard and a slump between 3 and 5-inches. Ready-mixed concrete shall be mixed and transported in accordance with ASTM C 94. Reinforcing steel shall conform to the requirements of ASTM A 615, Grade 60.

PART 3 EXECUTION

3.01 GENERAL

- A. Safety: Comply with local regulations and with the provisions of the "Manual of Accident Prevention in Construction" of the Associated General Contractors of America, Inc., Occupational Safety and Health Act and all other applicable safety regulations.
- B. Topsoil
 - 1. Remove all topsoil to a depth at which subsoil is encountered, from all areas under buildings, pavements and from all areas which are to be cut to lower grades or filled.
 - 2. With the Engineer's approval, topsoil to be used for finish grading may be stored on the site.
 - 3. Other topsoil may be used for fill in non-critical areas with approval of the Engineer.
 - 4. Properly dispose of all excess topsoil in the designated area.
- C. Bracing and Sheeting
 - 1. Furnish, put in place and maintain all sheeting, bracing and shoring as may be required to properly support the sides of all excavations and to prevent all movement of earth which could in any way injure the work, adjacent property or workers.
 - 2. Properly support all excavations where necessary to conform to all pertinent rules and regulations and these Specifications, even though, such locations are not indicated on the Drawings.
 - 3. Exercise care in the removal of sheeting, shoring, bracing and timbering to prevent collapse or caving of the excavation faces being supported and damage to the work and adjacent property.
 - 4. Do not leave any sheeting or bracing in the trench or excavation after completion of the work, unless approved by the Engineer.
- D. Obstructions
 - 1. Remove and dispose of all boulders, sidewalks, driveways, pavement, pipes and the like, as required for the performance of the work.
 - 2. Exercise care in excavating around catch basins, inlets and manholes so as to not disturb or damage these structures.
 - 3. Avoid removing or loosening castings or pushing dirt into catch basins, inlets and manholes.
 - 4. Damaged or displaced structures or casting shall be repaired, replaced and dirt entering the structures during the performance of the work shall be removed at no additional cost to the Owner.
- E. Utilities to be Abandoned
 - 1. When pipes, conduits, sewers, or other structures are removed from the trench, leaving dead ends in the ground, such ends shall be fully plugged or sealed with brick and non-shrink grout.

2. Abandoned structures such as manholes or chambers shall be entirely removed.
3. All materials from abandoned utilities shall be removed from the site.
4. All salvageable materials shall become the property of the Owner.
5. All equipment to be salvaged is noted in the Specifications and shall be turned over to the Owner at a designated location.

F. Extra Earth Excavation

1. In case soft or excessively wet material which, in the opinion of the Engineer, is not suitable, is encountered below the final subgrade elevation of an excavation or underneath a structure, the Engineer may order the removal of this material and its replacement with crushed stone, filter fabric, or other suitable material in order to make a suitable foundation for the construction of the structure.

G. Cutting Paved Surfaces and Similar Improvements

1. Remove existing pavement as necessary for installing pipe utilities and appurtenances or as otherwise shown on the Drawings.
2. Before removing any pavement, mark the pavement neatly, paralleling pipe lines and existing street lines. Space the marks the width of the trench.
3. Break asphalt pavement along the marks using rotary saws or other suitable tools. Break concrete pavement along the marks by use of scoring with a rotary saw and breaking below the score by the use of jackhammers or other suitable tools.
4. Do not pull pavement with machines until completely broken and separated from pavement to remain.
5. Do not disturb or damage the adjacent pavement. If the adjacent pavement is disturbed or damaged, remove and replace the damaged pavement. No additional payment will be made for removing and replacing damaged adjacent pavement.
6. Remove and replace sidewalks disturbed by construction for their full width and to the nearest undisturbed joint.
7. The Contractor may tunnel under curbs that are encountered. Remove and replace any curb disturbed by construction to the nearest undisturbed joint.

3.02 EXCAVATION

A. Method

1. All excavation shall be by open cut from the surface except as indicated on the Drawings.
2. All excavations for pipe appurtenances and structures shall be made in such a manner and to such depth and width, as will give ample room for building the structures and for bracing, sheeting and supporting the sides of the excavation, for pumping and draining groundwater which may be encountered and for the removal from the excavation of all materials excavated.
3. Take special care so that the soil below the bottom of the structure to be built is left undisturbed.

- B. Grades: Excavate to grades indicated on the Drawings. Where excavation grades are not indicated on the Drawings, excavate as required to accommodate installation.
- C. Disposal of Excavated Material
 - 1. Remove and properly dispose of all excavated material not needed to complete filling, backfilling and grading.
 - 2. Dispose of excess earth and rock excavated materials at locations on-site designated by the Engineer. Off-site disposal of all other material shall be and in accordance with all requirements of federal, state, county and municipal regulations. No debris of any kind shall be deposited in any stream or body of water, or on any street. No debris shall be deposited on any private property, except by written consent of the property owner. In no case shall any material be shoved onto abutting private properties, or be buried in embankments or trenches on the Project.

3.03 EXCAVATING FOR STRUCTURES

- A. Earth Excavation: Earth excavation shall include all substances to be excavated other than rock. Earth excavation for structures shall be to limits not less than two feet outside wall lines, to allow for formwork and inspection and further as necessary to permit the trades to install their work. All materials loosened or disturbed by excavation shall be removed from surfaces to receive concrete or crushed stone.
- B. Excavation for Foundations: Footings and slabs on grades shall rest on undisturbed earth, rock or compacted materials to insure proper bearing.
 - 1. Unsuitable Foundation Material: Any material, in the opinion of the Engineer, which is unsuitable for foundation shall be removed and replaced with compacted crushed stone, or with compacted fill material as directed by the Engineer. No determination of unsuitability will be made until all requirements for dewatering are satisfactorily met.
 - 2. Pipe Trenches Beneath Structures: Where piping or conduit passes beneath footings or slabs resting on grade, trenches shall be excavated to provide a minimum 6-inch clearance from all surfaces of the pipe or conduit. The trench shall be backfilled to the base of the structure with concrete.
 - 3. Unauthorized Excavation: Care shall be taken that excavation does not extend below bottom levels of footings or slabs on earth. Should the excavation, through carelessness or neglect, be carried below such levels, the Contractor shall fill in the resulting excess excavation with concrete under footings and compacted crushed stone or other approved material under slabs. Should excavation be carried beyond outside lines of footings such excess excavation shall be filled with concrete, or formwork shall be provided, as directed by the Engineer.
- C. Unsuitable Bearing
 - 1. If suitable bearings for foundations are not encountered at the elevations indicated on the Drawings, immediately notify the Engineer.
 - 2. Do not proceed further until instructions are received.

3.04 DEWATERING REQUIREMENT

- A. The Contractor may use any dewatering method they deem feasible so long as it results in working in the dry and stable soil conditions.
- B. The Contractor shall conform and meet all conditions, obtain necessary permits and

requirements of the regulatory agencies that have jurisdiction.

- C. It is the intent of these specifications that an adequate dewatering system be installed to lower and control the groundwater in order to permit excavation, construction, grading and the placement of fill materials, all to be performed under dry conditions. The dewatering system shall be adequate to pre-drain the water-bearing strata above and below the bottom of the excavation.
- D. The Contractor shall be solely responsible for the arrangement, location and depths of dewatering system necessary to accomplish the work described under this section of the specifications. The dewatering shall be accomplished in a manner that will reduce the hydrostatic head below any excavation to the extent that the water level in the construction area are a minimum of three (3) feet below the prevailing excavation surface and any surface to be compacted; will prevent the loss of fines, seepage, boils, quick conditions, or softening of the foundation strata; will maintain stability of the sides and bottom of the excavation; and will result in all construction operations being performed in the dry.
- E. The Contractor shall promptly dispose of all water removed from the excavations in such a manner as will not endanger public health, damage public or private property, or affect adversely any portion of the work under construction or completed by them or any other Contractor. Contractor shall obtain written permission from the Owner for any property involved before digging ditches or constructing water courses for the removal of water.
- F. The disposal of water from the dewatering system shall meet the requirements of all regulatory agencies having jurisdiction.
- G. If the dewatering requirements are not satisfied due to inadequacy or failure of the dewatering system, then loosening of the foundation strata, or instability of the slopes, or damage to the foundations or structures may occur. The supply of all labor and materials and the performance of all work necessary to carry out additional work for reinstatement of the structures of foundation soil resulting from such inadequacy or failure shall be undertaken by the Contractor subject to the approval of the Engineer and at no additional expense to the Owner.

3.05 COMPACTION

- A. Fill materials supporting roadways, parking areas, sidewalks, structures and buildings and backfill around structures shall be compacted to 95 percent of the standard proctor density. The top 12-inches of fill materials supporting structures or pavement shall be compacted to 98 percent of the standard proctor density. Fill placed for general site grading shall be compacted to 90 percent of the standard proctor density.
- B. Compaction of embankments shall be by vibratory sheepsfoot or pad-foot rollers with staggered, uniformly spaced knobs and suitable cleaning devices. The projected area of each knob and the number and spacing of the knobs shall be such that the total weight of the roller and ballast when distributed over the area of one row of knobs shall be 250 psi. Placement and compaction of materials shall extend at least 5 feet beyond the final contours sufficiently to insure compaction of the material at the resulting final surface. Final contours shall then be achieved by a tracked bulldozer shaping the face of the embankment.
- C. Compaction of backfill next to walls shall be accomplished with hand-powered tamping equipment. The backfill shall be placed in 8-inch maximum lifts, with each lift compacted to 95 percent of standard proctor density.
- D. If tests indicate that density of fill is less than that specified, the area shall be, as directed by the Engineer, either recompacted or undercut, filled and compacted until specified density is achieved.

3.07 FILL

A. Controlled Fill

1. The fill for roadways, parking areas, walks, structures and building slabs on grade shall be controlled fill.
2. After the existing ground or excavated area has been proofrolled and examined by the Engineer, all holes and other irregularities shall be filled and compacted before the main fill is placed.
3. The fill shall be placed in even layers not exceeding 8-inches in depth and shall be thoroughly compacted as herein specified.
4. If an analysis of the soil being placed shows a marked difference from one location to another, the fill being placed shall not be made up of a mixture of these materials.
5. Each different type of material shall be handled continuously so that field control of moisture and density may be based upon a known type of material.
6. No fill shall be placed following a heavy rain without first making certain on isolated test areas that compaction can be obtained without damage to the already compacted fill.

B. Proofrolling

1. All areas where roadways, parking areas, sidewalks, structures and buildings are to be constructed on cut areas, compacted fill and other areas where indicated on the Drawings, shall be proofrolled to detect soft spots prior to the placement of fill material or building foundations.
2. Proofrolling shall be performed using a fully loaded tandem-axle dump truck 20 tons or other suitable pneumatic tired equipment over the subgrade before the subgrade is shaped.
3. Proofrolling shall be witnessed by the Engineer.
4. Subgrade shall be proofrolled with 10 overlapping passes of the roller. Depressions that develop during the proofrolling operation shall be filled with suitable material and those filled areas shall be proofrolled with six passes of the roller. If, after having been filled and proofrolled, the subgrade areas that still "pump" or "rut", shall be further evaluated by a geotechnical engineer and remedial work be determined based on the conditions found at locations under structures or pavement. The contractor shall execute remedial work determined by the geotechnical engineer to achieve a subgrade acceptable to the Engineer.
5. After the proofrolled subgrade has been accepted by the Engineer, the surface of the subgrade shall be finish rolled with a smooth steel wheel roller weighing not less than 10 tons. Finished surface of the subgrade shall be within a tolerance of 1/4-inch at every point.
6. Conduits, pipes, culverts and underdrains shall be neither disturbed nor damaged by proofrolling operations. Rollers shall neither pass over, nor approach closer than five feet to, conduits, pipes, culverts and underdrains unless the tops of those products are deeper than three feet.

- C. Placement
 - 1. Prior to placement of any material in embankments, the area within embankment limits shall be stripped of topsoil and all unsuitable materials removed in accordance with this Section. The area shall then be scarified to a depth of at least 6-inches.
 - 2. Fill materials shall be placed in continuous, approximately horizontal layers extending the full width of the embankment cross-section and the full dimension of the excavation where practical and having an uncompacted thickness of not over 8-inches.
- D. Final Grading: Upon completion of construction operations, the area shall be graded to finish contour elevations and grades shown on the Drawings. Graded areas shall be made to blend into conformation with remaining ground surfaces. All surfaces shall be left smooth and free to drain.
- E. Excess Material: Surfaces and slopes of waste fills shall be left smooth and free to drain.
- F. Moisture
 - 1. Fill materials shall be placed at optimum moisture content within practicable limits, but not less or more than two percent of optimum. Optimum moisture shall be maintained by sprinkling the layers as placed or by allowing materials to dry before placement.
 - 2. If fill material is too wet, provide and operate approved means to assist the drying of the fill until suitable for compaction.
 - 3. If fill material is too dry, provide and operate approved means to add moisture to the fill layers.

3.08 BACKFILLING

- A. Backfill carefully to restore the ground surface to its original condition. Dispose of excess material in accordance with this Section.
- B. Compact backfill underlying roadways, parking areas, sidewalks, structures and buildings in accordance with the requirements of Article 3.06 of this Section.
- C. Backfilling Around Structures
 - 1. General
 - a. Remove debris from excavations before backfilling.
 - b. Do not backfill against foundation walls until so directed by the Engineer nor until all indicated perimeter insulation and/or waterproofing is in place.
 - c. Protect such insulation and/or waterproofing during filling operations.
 - d. Do not backfill against water retaining structures until successful leakage tests have been completed.
 - e. Wherever possible, backfilling shall be simultaneous on both sides of walls to equalize lateral pressures.
 - f. Do not backfill against walls until all permanent construction is in place to furnish lateral support on both top and bottom of wall.

- g. Backfilling against walls shall take place after all the concrete in the affected members has attained the specified strengths.
 - h. To prevent excessive lateral pressure on external walls, large compaction equipment shall not be allowed within a zone wall footing.
2. Materials: Backfill material placed against structures built or encountered during the work of this Section shall be suitable fill material. No broken concrete, bricks or similar materials will be permitted as backfill.

3.09 GRADING

- A. General: Perform all rough and finish grading required to attain the elevations indicated on the Drawings. Perform finish grading to an accuracy of ± 0.10 foot.
- B. Treatment After Completion of Grading
 - 1. After grading is completed, permit no further excavation, filling or grading, except with the approval of the Engineer.
 - 2. Use all means necessary to prevent the erosion of freshly graded areas during construction and until such time as permanent drainage and erosion control measures have been installed.

3.09 SETTLEMENT

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

3.13 CLEAN-UP

- A. Leave unused materials in a neat, compact stockpile.
- B. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.
- C. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

END OF SECTION

SECTION 31 10 00
SITE PREPARATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Selective demolition of built site elements.
- B. Clearing and protection of vegetation.
- C. Removal of existing debris.

1.02 RELATED SECTIONS

- A. Section 31 25 00 - Erosion and Sedimentation Control.
- B. Section 31 11 00- Clearing and Grubbing.
- C. Section 31 22 00 – Grading.
- D. Section 31 23 16 - Excavation.
- E. Section 31 23 23.13 – Backfill and Compaction.
- F. Section 31 23 23.33 – Control Density Fill

1.03 REFERENCES

- A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.
- B. NFPA 241 - Standard for Safeguarding Construction, Alteration and Demolition Operations; 2013.

1.04 SUBMITTALS

- A. Site Plan: Showing:
 - 1. Vegetation removal limits.
 - 2. Areas for temporary construction and field offices.
 - 3. Areas for temporary and permanent placement of removed materials.
- B. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.05 PROJECT CONDITIONS

- A. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers or other pollution.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 EXISTING UTILITIES

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least seven (7) days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least three (3) days prior written notification to Owner.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports and foundations of disconnected and abandoned utilities.
- H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.

3.02 VEGETATION

- A. Scope: Remove trees, shrubs, brush and stumps in areas to be improved.
- B. Do not begin clearing until vegetation to be relocated has been removed.
- C. Do not remove or damage vegetation beyond the following limits:
 - 1. Limits of Disturbance as illustrated on Construction Drawings
 - 2. 25 feet outside perimeter of pervious paving areas that must not be compacted by construction traffic.
 - 3. Exception: Specific trees and vegetation indicated on drawings to be removed.
 - 4. Exception: Selective thinning of undergrowth specified elsewhere.
- D. In areas where vegetation must be removed but no construction will occur other than pervious paving, remove vegetation with minimum disturbance of the subsoil.
- E. Vegetation Removed: Do not burn, bury, landfill, or leave on site, except as indicated.
 - 1. Chip, grind, crush or shred vegetation for mulching, composting, or other purposes; preference should be given to on-site uses.

2. Trees: Sell if marketable; if not, treat as specified for other vegetation removed; remove stumps and roots to depth of 18 inches.
 3. Existing Stumps: Treat as specified for other vegetation removed; remove stumps and roots to depth of 18 inches.
 4. Sod: Re-use on site if possible; otherwise sell if marketable, and if not, treat as specified for other vegetation removed.
 5. Fill holes left by removal of stumps and roots, using suitable fill material, with top surface neat in appearance and smooth enough not to constitute a hazard to pedestrians.
- F. Dead Wood: Remove all dead trees (standing or down), limbs and dry brush on entire site; treat as specified for vegetation removed.
- G. Restoration: If vegetation outside removal limits or within specified protective fences is damaged or destroyed due to subsequent construction operations, replace at no cost to Owner.

3.03 DEBRIS

- A. Remove debris, junk and trash from site.

3.04 WASTE REMOVAL

- A. Remove from site all materials not to be reused on site.
- B. Leave site in clean condition, ready for subsequent work.
- C. Clean up spillage and wind-blown debris from public and private lands.

3.05 MEASUREMENT AND PAYMENT

- A. No separate measurement or direct payment will be made for the work under this section and all costs for same shall be included in the overall lump sum bid for this project.

END OF SECTION

SECTION 31 11 00
CLEARING AND GRUBBING

PART 1 GENERAL

1.01 DESCRIPTION

- A. Work included: Remove all organic vegetative mater as required to complete the construction as indicated on the construction plans.
- B. Related work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions and Sections in Division 1 of these Specifications.
 - 2. Section 01 71 23 - Field Engineering.
 - 3. Section 31 10 00 - Site Preparation.
 - 4. Section 31 25 00 - Erosion and Sedimentation Control.
 - 5. Section 32 92 00 – Turf and Grasses.

1.02 QUALITY ASSURANCE

- A. Use required number of workmen that are properly trained and have experience in the crafts and who are completely familiar with the specified requirements herein and the methods for proper performance of the work specified in this section.
- B. Use the proper equipment that is adequate in size, capacity and numbers to accomplish the work within the timeframe of the Project schedule.
- C. Comply with requirements of governmental agencies having jurisdiction within the Project area.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 AREA INCLUDED

- A. All areas where new construction is taking place or as illustrated on the plans.

3.02 PROCEDURES

- A. Clearing and grubbing: The entire area within the limits described above shall be cleared and grubbed at a minimum depth of 6-inches.
- B. Areas that are to be selectively cleared shall consist of removing vegetation, brush, stumps, etc., from the area. Special care shall be taken to avoid damage to trees that are left. Grubbing will not be required in areas designated for selective clearing.
- C. Removal of trees and shrubs: All trees being taken down must be removed avoiding damage to trees and existing features that are to remain. All parts of the trees being

removed are to be completely taken from the site and properly disposed of. Any shrubs or small trees that are undesirable may be selectively removed as directed.

- D. Stumps and roots: All stumps and roots larger than 2-inches in diameter shall be completely removed by grubbing except in areas of building site, parking areas and drives; they must be cut off no less than 18-inches below any subgrade. The area of operation then shall be cleared of resulting debris and matted roots, weeds and other organic matter shall be hauled away from the site. Generally, all material that cannot be compacted to 90-percent maximum density in lawn areas and 95-percent of maximum density elsewhere must be removed.
- E. Protection of trees: Trees that are to remain in place will need to be protected in areas where earthwork cut or fill is eighteen inches or less and in existing parking areas. Contractor must obtain approval from Engineer prior to removal of significant trees covered by local tree ordinances. Existing trees that are remaining in place during and after construction must be protected by constructing barricades around each tree.
- F. Erosion and Sediment Control: Construct and maintain erosion and sediment control devices as illustrated on the construction plans and in accordance with Section 31 25 00 – Erosion and Sedimentation Control of these specifications.

3.03 MEASUREMENT AND PAYMENT

- A. No separate measurement or direct payment will be made for the work under this Section and all costs for same shall be included in the lump sum price bid.

END OF SECTION

SECTION 31 22 00

GRADING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Work included: Cut, fill, excavate, backfill, compact and grade the site as necessary to bring the roads, drives, building sites, paved areas and open areas to the lines and grades shown on the drawings.
 - 1. The work includes, but is not necessarily limited to:
 - a. Building site preparation.
 - b. Roadway, parking area, drive and walk subgrade preparation.
 - c. Excavations and formations of embankments.
 - d. Dressing of graded areas, shoulders and ditches.
 - 2. Subsurface Classification: All excavation is unclassified and excavation of every description, regardless of material encountered within the grading limits of the project, shall be performed to the lines and grades indicated.
- B. Removal and storage of topsoil.
- C. Rough grading the site for improvements.
- D. Topsoil and finish grading.

1.02 RELATED SECTIONS

- A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions and Sections in Division 1 of these specifications.
- B. Section 31 11 00 - Clearing and Grubbing.
- C. Section 31 25 00 - Erosion and Sedimentation Control.
- D. Section 31 23 16 - Excavation.
- E. Section 31 23 16.13 – Trenching for Site Utilities
- F. Section 31 23 23.13 - Backfill and Compaction
- G. Section 32 11 23 - Aggregate Base Course.
- H. Section 32 92 00 - Turf and Grasses.

1.03 Definitions

- A. Open areas: Open areas shall be those areas that do not include building sites, paved areas, street right-of-way and parking areas.

- B. Maximum density: Maximum weight in pounds per cubic foot of a specific material.
- C. Optimum moisture: Percentage of water in a specific material at maximum density.
- D. Rock excavation: Excavation of any hard natural substance which requires the use of explosives and/or special impact tools such as jack hammers, sledges, chisels or similar devices specifically designed for use in cutting or breaking rock, but exclusive of trench excavating machinery. To be considered as rock excavation, the material shall be continuous; individual boulders or rocks in soil will not be considered rock excavation.
- E. Muck: Materials unsuitable for foundation because of organic content, saturation to the extent that it is somewhat fluid and must be removed by dragline, dredge or other special equipment, are designated as muck. No extra payment will be made for muck removal.
- F. Unsuitable material: Unsuitable material is defined as earth material unsatisfactory for its intended use and as classified by the soils technician. In addition to organic matter, sod, muck, roots and rubbish, highly plastic clay soils of the CH and MH descriptions and organic soils of the OL and OH descriptions, as defined in the Unified Soil Classification System shall be considered as unsuitable material.
- G. Suitable material: Where the term suitable material is used in specification sections pertaining to earthwork, it means earth or materials designated as being suitable for their intended use by soils technicians or the Engineer. Suitable material shall be designated as meeting the requirements of the Unified Soil Classification System types SW, GW, GC, SC, SM, ML, CL or as designated in these specifications.
- H. Select material: Select material is defined as granular material to be used where indicated on the drawings or where specified herein consisting of soils conforming to the Unified Soil Classification types SW, SM, GW or GM or as otherwise approved by the Engineer as select fill. Select material shall contain no stones or rubble larger than 1-1/2 inches in diameter.
- I. Crushed stone (gravel): Crushed stone shall be No. 57 aggregate or equal conforming to ASTM C-33.
- J. Excavation: Excavation is defined as unclassified excavation of every description regardless of materials encountered.

1.04 SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts and slope gradients.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with State of South Carolina, Department of Transportation standards.
- B. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- C. Comply with requirements of governmental agencies having jurisdiction.

- D. A testing laboratory, retained by the Contractor and approved by the Owner, will make such tests as are deemed advisable. Test as specified in Section 01 45 29, Testing Laboratory Services.
- E. The Contractor shall schedule their work so as to permit a reasonable time for testing before placing succeeding lifts of fill material and shall keep the laboratory informed of their progress. The cost of the initial tests shall be paid for by the Contractor. Subsequent tests required as a result of improper compaction shall also be paid for by the Contractor.
- F. Contractor shall provide all required equipment and contact Engineer to setup time for Proof Roll Testing across all areas that have been graded. The Engineer and Geotechnical Engineer will provide final approval to the Contractor during site visit. Any additional cost required from multiple testing visits and trip will be the responsibility of the Contractor, not the Owner nor Engineer.

1.06 PROJECT CONDITIONS

- A. Protect above- and below-grade utilities that remain.
- B. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving and curbs from grading equipment and vehicular traffic.
- C. The Contractor must determine for themselves the volume of material required by the site.

1.07 PRODUCT HANDLING

- A. Comply with pertinent provisions of Section 01 60 00 - Product Requirements.

1.08 JOB CONDITIONS

- A. Notification of intent to excavate:
 - 1. South Carolina Underground Utility Damage Prevention Act (S.C. Code Ann, 58-35-10, 2012) requires persons to ascertain the location of underground public utility property prior to excavation or demolition in certain situations. The Act also requires such persons to give timely notice of intent to excavate or demolish prior to commencing such operations. Failure to comply could subject the violator to a civil penalty of up to one thousand dollars (\$1,000) for each violation of the Act.
 - 2. Notification of intent to excavate may be given by calling this toll free number: 1-800-922-0983.

PART 2 PRODUCTS

2.01 SOIL MATERIALS

- A. General:
 - 1. Soil material used as fill, backfill, subgrade for structures or pavements, embankments, or site grading shall consist of suitable material as found available on site until such supply of on-site material is depleted.
 - a. Provide suitable material free from organic matter and deleterious substances, containing no rocks or lumps over 6 inches in greatest dimension and with not more than 15% of the rocks or lumps larger than

2-1/2 inches in their greatest dimension.

- b. Do not permit rocks having a dimension greater than 1 inch in the upper 6 inches of fill or embankment.
 - 2. Should the quantity of suitable on-site material be insufficient to complete the work, suitable borrow material as approved by the Engineer shall be provided by the Contractor at no additional expense to the Owner.
 - 3. Select materials may be provided from on-site if acceptable material as approved by the Engineer is available on site. Otherwise approved select material shall be provided by the Contractor from an off-site source.
- B. Topsoil:
- 1. Use topsoil consisting of material removed from the top 3 to 6 inches of existing on-site soils.
 - 2. Use topsoil containing no stones, roots or large clods of soil.
 - 3. Stockpile topsoil separate from other excavated material.

2.02 WEED KILLER

- A. Provide a dry, free-flowing, dust free chemical compound, soluble in water, capable of inhibiting growth of vegetation and approved for use on this work by governmental agencies having jurisdiction.

2.03 EQUIPMENT

- A. Use equipment adequate in size, capacity and numbers to accomplish the work in a timely manner without undue waste or damage of material.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that survey bench mark and intended elevations for the Work are as indicated.
- B. Surface Conditions:
 - 1. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION

- A. Identify required lines, levels, contours and datum.
- B. Stake and flag locations of known utilities.
- C. Locate, identify and protect utilities that remain, from damage.
- D. Notify utility company to remove and relocate utilities.
- E. Clearing and grubbing: Clear and grub areas to be graded prior to commencement of the

grading operations.

- F. Where so directed by the Owner, protect and leave standing designated desirable trees.
- G. Complete any demolition and/or removal work as may be required prior to grading operations.
- H. Dispose of all clearing, grubbing and demolition debris and other deleterious material off the project site. Vegetation, roots, brush, rubbish, stumps, etc. may be burned on-site where permitted by local authorities and regulations and approved by the Engineer.
- I. Topsoil: Strip topsoil to a depth of 3 to 6 inches without contamination from the subsoil and stockpile topsoil separate from other excavated materials.
 - 1. Transport and deposit topsoil in storage piles convenient to areas that are to receive topsoil or in other locations as indicated or approved by the Engineer.
 - 2. Deposit topsoil in areas that are already graded and will not be disturbed by on-going construction.
 - 3. Dispose of unsuitable or unusable stripped material off-site or as otherwise directed by the Engineer.
- J. Sampling and preliminary testing:
 - 1. Prior to beginning the grading operations, the Contractor shall submit to the Engineer their proposed sequence of excavation operations.
 - 2. Based upon the sequence of excavation, samples of the fill materials will be obtained as excavation proceeds and tested for grain size permeability and moisture density relationship using the Standard Proctor Method (ASTM D698, Method A).
 - 3. Allow sufficient time for completion of laboratory tests before any fill operations begin, using the soils being tested.

3.03 ROUGH GRADING

- A. Remove topsoil from areas to be further excavated, re-landscaped, or re-graded, without mixing with foreign materials.
- B. Remove subsoil from areas to be further excavated, re-landscaped, or re-graded.
- C. Do not remove wet subsoil, unless it is subsequently processed to obtain optimum moisture content.
- D. When excavating through roots, perform work by hand and cut roots with sharp axe.
- E. Perform excavating of every type of material encountered within the limits of the Work to the lines, grades and elevations indicated and specified herein.
- F. Suitable excavated materials:
 - 1. Use all suitable materials removed from the excavation as far as practicable in the formation of the embankments, subgrades, shoulders, building sites and other

places as directed.

2. Unless otherwise indicated on the drawings or approved by the Engineer, surplus suitable material shall be removed from the site and disposed of by the Contractor.
- G. Unsuitable excavated material: Remove from the site and dispose of all unsuitable material unless otherwise approved by the Engineer.
- H. Rock excavation:
1. Notify the Engineer upon encountering rock or similar material which cannot be removed or excavated by conventional earth moving or ripping equipment.
 2. Do not use explosives without written permission from the Engineer.
 3. When explosives are permitted, use only experienced powdermen or persons who are licensed or otherwise authorized to use explosives. Store, handle and use explosives in strict accordance with all regulatory bodies and the "Manual of Accident Prevention in Construction" of the Associated General Contractors of America, Inc.
 4. The Contractor shall be solely responsible for any damage resulting from the use of explosives.
 5. The Contractor is responsible for securing all permit required in performing this work.
- I. Unauthorized excavation:
1. Excavation of material to depths below the grades indicated unless so directed by the Engineer will be deemed unauthorized excavation.
 2. Unauthorized overexcavation shall be backfilled and compacted without any additional expense to the Owner.
- J. In the event that it is necessary to remove unsuitable material to a depth greater than that shown on the drawings or otherwise specified, the Contractor, upon receiving direction from the Engineer, shall remove, replace and compact such material as directed by the Engineer at no additional expense by the Owner.
- K. Filling and Backfilling
1. Use fills formed of suitable material placed in layers of not more than 8" in depth measured loose and rolled and/or vibrated with suitable equipment until compacted.
 2. Do not place rock that will not pass through a 6-inch diameter ring within the top 12 inches of the surface of the completed fill or rock that will not pass through a 3 inch diameter ring within the top 6 inches of the completed fill.
 3. Do not use broken concrete or asphaltic pavement in fills.
 4. Selection of borrow material:
 - a. Material in excess of that available on the site shall be suitable material

furnished by the Contractor from private sources selected by the Contractor. The material shall be approved by the Engineer before use. All expenses involved in securing, developing, transporting and placing the material shall be borne by the Contractor.

L. Placing and compacting:

1. Place backfill and fill materials in layers not more than 8 inches in loose depth.
2. Before compacting, moisten or aerate each layer as necessary to provide the optimum moisture content.
3. Compact each layer to required percentage of maximum density for the area.
4. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
5. Place backfill and fill materials evenly adjacent to structures, to required elevations.
6. Take care to prevent wedging action of backfill against structures by carrying the material uniformly around the structures to approximately the same elevation in each lift.

M. Moisture control:

1. Do not use soil material that is either too dry or too wet to achieve proper compaction.
2. Where subgrade or layer of soil material is too dry to achieve proper compaction, uniformly apply water to surface of soil material such that free water does not appear on the surface during or subsequent to compacting operations.
3. Remove and replace, or scarify and air dry, soil material that is too wet to permit compacting to the specified density.
4. Soil material that has been removed because it is too wet to permit compacting may be stockpiled or spread and allowed to dry. Assist drying by disking, harrowing, or pulverizing until moisture content is reduced to a satisfactory value as determined by moisture-density relation tests approved by the Engineer.

N. Compaction requirements:

1. Compact soils to not less than the following percentages of maximum dry density as determined in accordance with ASTM D698, Method A (Standard Proctor).
2. Fill beneath structures and beneath an area extending 10' beyond the limits of the foundation:
 - a. Top 12 inches of Subgrade 100%
 - b. All other fill material 98%
3. Beneath Roadways:
 - a. Top 12 inches of Subgrade 100%

- b. All other fill material 95%
 - 4. Embankments:
 - a. Top 12 inches of Subgrade 98%
 - b. All other fill material 95%
 - 5. Beneath Sidewalks:
 - a. Top 12 inches of Subgrade 95%
 - b. All other fill material 90%
 - 6. Lawns and unpaved areas:
 - a. All other fill material 90%
- O. Placing of Special Materials:
 - 1. Placing impervious liner materials:
 - a. Place selected fine grain soils on bottom and side slopes of the basin to the indicated depth.
 - b. Inspect and proofroll the stripped and grubbed subgrade prior to placement of any liner material, as specified hereinafter.
 - c. Spread liner material in 8-inch maximum, loose lift thickness to provide a 6 inch compacted lift thickness.
 - d. Adjust soil moisture content to 1 to 3 percentage points "wet" of the optimum moisture contents.
 - e. Compact at 98% of maximum density.
 - f. Maintain liner material sufficiently moist to prevent drying and cracking, until such time as the basin is filled.
- P. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.

3.04 SOIL REMOVAL

- A. Stockpile excavated topsoil on site.
- B. Stockpile subsoil to be re-used on site; remove remainder from site.
- C. Stockpiles: Use areas designated on site; pile depth not to exceed 8 feet (2.5 m); protect from erosion.

3.05 FINISH GRADING

- A. General:
 - 1. Uniformly grade the areas within limits of grading under this Section, including adjacent transition areas.
 - 2. Smooth the finished surfaces within specified tolerance.
 - 3. Grade with uniform levels or slopes between points where elevations are shown on the drawings, or between such points and existing grades.
 - 4. Where a change of slope is indicated on the drawings, construct a rolled transition section having a minimum radius of approximately 8'-0", unless adjacent construction will not permit such a transition, or if such a transition defeats positive control of drainage.
- B. Before Finish Grading:
 - 1. Verify subgrade has been contoured and compacted.
- C. Remove debris, roots, branches, stones, in excess of 1/2 inch (13 mm) in size. Remove soil contaminated with petroleum products.
- D. Grading adjacent to structures: Grade areas adjacent to buildings to achieve drainage away from the structures and to prevent ponding.
- E. Ditches and gutters and swales:
 - 1. Cut accurately to the cross sections, grades and elevations shown.
 - 2. Maintain excavations free from detrimental quantities of leaves, sticks, trash and other debris until completion of the work.
 - 3. Dispose of excavated materials as specified herein; do not in any case deposit materials within 3'0" of the edge of a ditch.
- F. Upon completion of site grading and other related site work, topsoil shall be uniformly spread over the graded or improved areas. Topsoil shall be evenly distributed to conform to final grade elevations shown on the plans.
- G. Where topsoil is to be placed, scarify surface to depth of 3 inches (75 mm).
- H. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 3 inches (75 mm).
- I. Place topsoil in areas where grassing/seeding are indicated.
- J. Place topsoil to the following compacted thicknesses:
- K. Areas to be seeded with grass not less than: 3 inches (75 mm).
- L. Place topsoil during dry weather.
- M. Remove roots, weeds, rocks and foreign material while spreading topsoil.

- N. Near plants spread topsoil manually to prevent damage.
- O. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.
- P. Lightly compact placed topsoil.
- Q. Any surplus topsoil materials shall be disposed of in approved areas on the site.

3.06 TOLERANCES

- A. Top Surface of Subgrade: Plus or minus 1/10 foot (30 mm) from required elevation.
- B. Top Surface of Finish Grade: Plus or minus 1/2 inch (13 mm).
- C. Construct areas outside of building or structure lines true to grades shown.
 - 1. Where no grade is indicated, shape finish surface to drain away from buildings or structures, as approved by the Engineer.
- D. Degree of finish shall be that ordinarily obtainable from bladegrader, supplemented with hand raking and finishing.

3.07 FIELD QUALITY CONTROL

- A. See Section 31 23 23.13 - Backfill and Compaction, for compact density testing and the following:
- B. Secure the Engineer's construction review and observation and approval of subgrades and fill layers before subsequent construction is permitted thereon.
- C. Field density determinations will be made, at no additional cost to the Owner, to ensure that the specified densities are being obtained. Field density tests will be performed as determined by the Engineer, considering the following:
 - 1. At areas to receive paving, at least one field density test for every 5,000 sq. ft. of subgrade area, but not less than three tests.
 - 2. In each compacted fill layer, one field density test for every 5,000 sq. ft. of overlying paved area, but not less than three tests.
 - 3. In fill beneath structures, one field density test for every 2,500 sq. ft. in each layer.
 - 4. Other tests as deemed necessary by the Engineer.
- D. If, in the Engineer's opinion based on reports of the testing laboratory, subgrade or fills which have been placed are below specified density, provide additional compacting and testing until specified requirements are met.
 - 1. Additional testing will be provided by the Owner-approved testing laboratory and all costs for the additional testing will be borne by the Contractor.

- E. Proofrolling:
 - 1. The Contractor shall proofroll subgrade of areas to receive paving, structures on fill or impervious lining material.
 - a. Make not less than 3 passes of a 25 to 50 ton rubber tired roller over the full area.
 - b. Unstable, soft or otherwise unsuitable materials revealed by the proofrolling shall be removed and replaced with satisfactory materials, compacted as specified herein.

3.08 CLEANING AND PROTECTION

- A. Remove unused stockpiled topsoil and subsoil. Grade stockpile area to prevent standing water.
- B. Leave site clean and raked, ready to receive landscaping.
- C. Existing utilities:
 - 1. Unless shown to be removed, locate and protect active utility lines shown on the drawings or otherwise made known to the Contractor prior to excavating. If damaged, repair or replace at no additional cost to the Owner.
 - 2. If active utility lines are encountered and are not shown on the drawings or otherwise made known to the Contractor, promptly notify the Engineer and take necessary steps to assure that service is not interrupted.
 - 3. If service is interrupted as a result of work under this Section, immediately restore service by repairing the damaged utility at no additional cost to the Owner.
 - 4. If existing utilities are found to interfere with the permanent facilities being constructed under this Section, immediately notify the Engineer and secure their instructions.
 - 5. Do not proceed with permanent relocation of utilities until written instructions are received from the Engineer.
- D. Protection of persons and property:
 - 1. Barricade open holes and depressions occurring as part of this Work and post warning lights on property adjacent to or with public access.
 - 2. Operate warning lights during hours from dusk to dawn each day and as otherwise required.
 - 3. Protect structures, utilities, sidewalks, pavements and other facilities from damage caused by settlement, lateral movement, washout and other hazards created by operations under this Section.
- E. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors and to other work being performed on or near the site.
- F. Maintain access to adjacent areas at all times.

- G. Excavate and backfill in a manner and sequence that will provide proper drainage at all times.

3.09 MAINTENANCE

- A. Protection of newly graded areas:
 - 1. Protect newly graded areas from traffic and erosion and keep free from trash and weeds.
 - 2. Repair and re-establish grades in settled, eroded and rutted areas to the specified tolerances.
- B. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, reshape and compact to the required density prior to further construction.

3.10 MEASUREMENT AND PAYMENT

- A. No separate measurement or direct payment will be made for the work under this Section and all costs for same shall be included in the lump sum bid price.

END OF SECTION

SECTION 31 23 16

EXCAVATION

PART 1 GENERAL

1.01 WORK REQUIRED BY THIS SECTION

- A. Excavating for Utility Structures, Water and Wastewater Lines

1.02 RELATED SECTIONS

- A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions and Sections in Division 01 of these Specifications.
- B. Section 01 70 00 - Execution Requirements: General requirements for dewatering of excavations and water control.
- C. Section 31 22 00 - Grading.
- D. Section 31 23 23.13 - Backfill and Compaction.
- E. Section 31 23 16.13 – Trenching for Site Utilities.
- F. Section 31 37 00 - Riprap.
- G. Section 31 25 00 - Erosion and Sedimentation Control.

1.03 PROJECT CONDITIONS

- A. Verify that survey benchmarks and intended elevations for the Work are as indicated.
- B. Protect plants, lawns, rock outcroppings and other features to remain.
- C. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving and curbs from excavating equipment and vehicular traffic.

1.04 CLASSIFICATION:

- A. Classification: All excavation is unclassified and excavation of every description, regardless of material encountered within the excavation limits of the structure, shall be performed to the lines and grades indicated.

1.05 DEFINITIONS:

- A. Open areas: Open areas shall be those areas that do not include building sites, paved areas, street right-of-way and parking areas.
- B. Maximum density: Maximum weight in pounds per cubic foot of a specific material.
- C. Optimum moisture: Percentage of water in a specific material at maximum density.
- D. Rock excavation: Excavation of any hard natural substance which requires the use of explosives and/or special impact tools such as jack hammers, sledges, chisels or similar devices specifically designed for use in cutting or breaking rock, but exclusive of trench excavating machinery. To be considered as rock excavation, the material shall be continuous; individual boulders or rocks in soil will not be considered rock excavation.

- E. Muck: Materials unsuitable for foundation because of organic content, saturation to the extent that it is somewhat fluid and must be moved by dragline, dredge, or other special equipment, are designated as muck. No extra payment will be made for muck removal.
- F. Unsuitable material: Unsuitable material is defined as earth material unsatisfactory for its intended use and as classified by the soils technicians. In addition to organic matter, sod, muck, roots and rubbish, highly plastic clay soils of the CH and MH descriptions and organic soils of the OL and OH descriptions, as defined in the Unified Soil Classification System shall be considered as unsuitable material.
- G. Suitable material: Where the term suitable material is used in specification sections pertaining to earthwork, it means earth or materials designated as being suitable for their intended use by soils technicians or the Engineer. Suitable material shall be designated as meeting the requirements of the Unified Soil Classification System types SW, GW, GC, SC, SM, ML, CI or as designated in these specifications.
- H. Select material: Select material is defined as granular material to be used where indicated on the drawings or where specified herein consisting of soils conforming to the Unified Soil Classification types SW, SM, GW, or GM or as otherwise approved by the Engineer as select fill. Select material shall contain no stones or rubble larger than 1-1/2 inches in diameter.
- I. Crushed stone (gravel): Crushed stone shall be No. 57 aggregate or equal conforming to ASTM C 33.
- J. Excavation: Excavation is defined as unclassified excavation of every description regardless of materials encountered.

1.06 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Comply with requirements of governmental agencies having jurisdiction
- C. Testing: A testing laboratory, retained by the Contractor and approved by the Owner, will make such tests as are deemed advisable. Test as specified in Section 01 45 29, Testing Laboratory Services.
 - 1. Schedule fill and backfill operations so as to permit a reasonable time for inspection and testing before placing succeeding lifts and keep the laboratory and Engineer informed of progress.
 - 2. Notify the Engineer and allow sufficient time for observation and/or testing of foundation subgrades prior to commencing any work on the exposed excavation.

1.07 JOB CONDITIONS

- A. If conditions encountered during construction warrant additional removal of unsuitable material below foundation subgrades, then remove unsuitable material and replace it as specified at no additional expense to the Owner.

1.08 PRODUCT HANDLING

- A. Comply with pertinent provisions of Section 01 60 00.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 PREPARATION

- A. Identify required lines, levels, contours and datum locations.
- B. See Section 31 22 00 - Grading, for additional requirements.
- C. Locate, identify and protect utilities that remain and protect from damage.
- D. Notify utility company to remove and relocate utilities.

3.02 EXCAVATING

- A. Underpin adjacent structures that could be damaged by excavating work.
- B. Excavate to accommodate new structures and construction operations.
- C. Notify Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- D. Preparation for Piling Work: Excavate to working elevations. Coordinate special requirements for piling.
- E. Slope banks of excavations deeper than 4 feet (1.2 meters) to angle of repose or less until shored.
- F. Do not interfere with 45 degree bearing splay of foundations.
- G. Cut utility trenches wide enough to allow inspection of installed utilities.
- H. Hand trim excavations. Remove loose matter.
- I. Remove lumped subsoil, boulders and rock up to 1/3 cu yd (0.25 cum) measured by volume.
- J. Correct areas that are over-excavated and load-bearing surfaces that are disturbed; See Section 31 23 23.13 – Backfill and Compaction.
- K. Conform to elevations and dimensions shown within a tolerance of 0.10 feet and extending a sufficient distance from footings and foundations to permit placing and removing concrete formwork, installation of services, other construction required and for construction observation.
- L. Where earth will stand, shallow footing excavations may be cut to the exact size of the footing.
- M. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- N. Remove excavated material that is unsuitable for re-use from site.
- O. Stockpile excavated material to be re-used in area designated on site in accordance with Section 31 22 00 - Grading.

- P. Remove excess excavated material from site.

3.03 FOUNDATION SUBGRADES

- A. Excavate foundations and footings to a level bottom in firm, solid, suitable material.
- B. Take care not to disturb the bottom of the excavation unless further compaction of the subgrade is required.
- C. Notify the Engineer in due time to permit observation of the completed excavation prior to performing work on the foundation subgrade.
- D. Should unsuitable or soft material be encountered at subgrade elevation, remove such material and replace with compacted suitable material or crushed stone from firm earth up to the indicated elevation.
 - 1. In wet excavations or where groundwater is normally present, replace unsuitable material with crushed stone or lean concrete.
 - 2. In dry excavations above the normal groundwater level, replace unsuitable material with compacted suitable material.
 - 3. Unsuitable material shall be removed and replaced at no expense to the Owner.
 - 4. Where rock is encountered at foundation level:
 - a. Use drilling, picking, wedging or similar methods leaving the foundation rock in an entirely solid and unshattered condition.
 - b. Roughen approximately level surfaces to provide satisfactory bond with concrete.
 - c. Cut steps or benches in sloped surfaces to provide satisfactory bond.

3.04 DRAINAGE

- A. Provide drainage and control grading in the vicinity of the work to prevent drainage into the excavation.

3.05 ROCK EXCAVATION

- A. Notify the Engineer upon encountering rock or similar material that cannot be removed or excavated by conventional earth moving or ripping equipment.
- B. Do not use explosives without written permission from the Engineer.
- C. When explosives are permitted, use only experienced powdermen or persons who are licensed or otherwise authorized to use explosives. Store, handle and use explosives in strict accordance with all regulatory bodies and the "Manual of Accident Prevention in Construction" of the Associated General Contractors of America, Inc.
- D. The Contractor shall be solely responsible for any damage resulting from the use of explosives.
- E. The Contractor is responsible for securing all permits required in performing this work.

- F. Do not use blasting adjacent to existing buildings or structures. Remove rock at such locations using jack hammers and bull points.

3.06 UNAUTHORIZED EXCAVATION

- A. Excavation of material to depths below the grades indicated unless so directed by the Engineer will be deemed unauthorized excavation.
- B. Backfill and compact unauthorized over excavation at no expense to the Owner.
 - 1. In wet excavations or excavations below normal groundwater elevations: Use crushed stone or lean concrete as directed by the Engineer.
 - 2. In dry excavations above normal groundwater elevations: Use compacted suitable material.

3.07 DEWATERING

- A. Remove all surface and subsurface waters from excavations and maintain the excavation in a dry condition during construction operations.
- B. Maintain the water level below the excavation subgrade during excavation and construction.
 - 1. Material disturbed below the foundation subgrade due to improper dewatering shall be removed and replaced with crushed stone or lean concrete at no expense to the Owner.
 - 2. Use sumps, pumps, drains, trenching or well point system as necessary to maintain a dry excavation.
 - 3. Dewatering by trench pumping will not be permitted if migration of fine grained natural material (running sand) from bottom, side walls or bedding material will occur.
- C. Dispose of water pumped from excavations in storm drains having capacity, canals, trenches or other approved locations.
 - 1. Contractor is responsible for acquiring all permits required to discharge the water and shall protect waterways from turbidity during the operation.
 - 2. Prevent flooding of streets, roadways, or private property.
 - 3. Provide engines driving dewatering pumps with residential type mufflers.

3.08 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection and testing.
- B. Provide for visual inspection of load-bearing excavated surfaces before placement of foundations.

3.09 PROTECTION

- A. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.

- B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.
- C. Protect structures, sidewalks, pavements and other facilities from damage caused by settlement, lateral movement, washout and other hazards created by operations under this Section.
- D. Unless shown to be removed, locate and protect active utility lines shown on the drawings or otherwise made known to the Contractor prior to excavating. If damaged, repair or replace at no additional cost to the Owner.
- E. If active utility lines are encountered and are not shown on the drawings or otherwise made known to the Contractor, promptly notify the Engineer and take necessary steps to assure that service is not interrupted.
- F. Barricade open holes and depressions occurring as part of this work and post warning lights on property adjacent to or with public access. Operating warning lights during hours from dusk to dawn each day and as otherwise required.
- G. Side slopes: Slope, bench and/or shore sides of excavations and trench walls to maintain stability of the wall or sides. Pile materials obtained from the excavation a minimum of four feet from the edge of the excavation.
- H. Shoring and sheeting: Where necessary, shore and sheet excavations with members of sizes and arrangement sufficient to prevent injury to persons, damage to structures or injurious caving or erosion.
 - 1. Furnish, put in place and maintain such sheeting and bracing as may be required to support the sides of excavations, to prevent any movement which could in any way diminish the width of the excavation below that necessary for proper construction and to protect adjacent structures from undermining or other damage. Any movement or bulging that may occur shall be corrected immediately by the Contractor. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed, they shall be immediately filled and compacted.
 - 2. Take all precautions to prevent distress of existing structures because of sheeting installation or removal. Where the removal of sheeting may cause damage to existing or newly constructed structures, such sheeting shall be left in place at no expense to the Owner.
 - 3. All sheeting and shoring operations and maintenance thereof shall be the responsibility of the Contractor.

3.10 MEASUREMENT AND PAYMENT

- A. No separate measurement or direct payment will be made for the work under this Section and all costs for same shall be included in the lump sum bid.

END OF SECTION

SECTION 31 23 16.13

TRENCHING FOR SITE UTILITIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Backfilling and compacting for underground utilities.

1.02 RELATED REQUIREMENTS

- A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Sections in Division 1 of these Specifications.
- B. Section 01 71 23 - Field Engineering.
- C. Section 31 22 00 - Grading.
- D. Section 31 23 16 - Excavation.
- E. Section 31 23 23.13 – Backfill and Compaction.
- F. Section 33 41 00 - Storm Utility Drainage Piping.

1.03 DEFINITIONS

- A. Subgrade Elevations: Indicated on drawings.

1.04 REFERENCES

- A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; American Association of State Highway and Transportation Officials; 2010 (2009).
- B. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2006.
- C. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)); 2012.
- D. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2007.
- E. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN m/m³)); 2012.
- F. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2008.
- G. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2011.
- H. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth); 2005.

- I. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2005.
- J. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils; 2010.
- K. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2010

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Samples: 10 lb. sample of each type of fill; submit in air-tight containers to testing laboratory.
- C. Materials Sources: Submit name of imported materials source.
- D. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- E. Compaction Density Test Reports.

1.06 DELIVERY, STORAGE AND HANDLING

- A. When necessary, store materials on site in advance of need.
- B. When fill materials need to be stored on site, locate stockpiles where indicated.
 - 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
 - 2. Prevent contamination.
 - 3. Protect stockpiles from erosion and deterioration of materials.
- C. Verify that survey bench marks and intended elevations for the Work are as indicated.
- D. Protect plants, lawns, rock outcroppings and other features to remain.
- E. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving and curbs from excavating equipment and vehicular traffic.

1.07 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Use equipment adequate in size, capacity and numbers to accomplish the work in a timely manner.

1.08 JOB CONDITIONS

- A. Existing utilities:

1. Approximate location of certain underground lines and structures are shown on the plans for information only, other underground lines or structures are not shown.
2. Locate these and other possible unknown utility lines using electronic pipe finder, or other approved means.
3. Locate, excavate and expose all existing underground lines in advance of trenching operations.
4. The Contractor will be held responsible for the workmanlike repair of any damage done to any of these utilities in the execution of their work under this Section.
5. The Contractor shall familiarize themselves with the existing conditions and be prepared to adequately care for and safeguard themselves and the Owner from damage.

B. Notification of intent to excavate:

1. South Carolina Underground Utility Damage Prevention Act (S.C. Code Ann, 58-35-10, CT-SEQ, Supp. 1978) requires persons to ascertain the location of underground public utility property prior to excavation or demolition in certain situations. The Act also requires such persons to give timely notice of intent to excavate or demolish prior to commencing such operations. Failure to comply could subject the violator to a civil penalty of up to one thousand dollars (\$1,000) for each violation of the Act.
 - a. Notification of intent to excavate may be given by calling this toll free number: 811.

C. Protecting trees, shrubbery and lawns:

1. Trees and shrubbery in developed areas and along the trench line shall not be disturbed unless absolutely necessary and subject to the approval of the Engineer.
 - a. Any such trees and shrubbery necessary to be removed shall be heeled in and replanted.
2. Where trenches cross private property through established lawns, sod shall be cut, removed, stacked and maintained in suitable condition until replacement is approved by the Engineer.
 - a. Topsoil underlying lawn areas shall be removed and kept separate from general excavated materials.

D. Clearing:

1. Perform all clearing necessary for installation of the complete work.
2. Clearing shall consist of removing all trees, stumps, roots, brush and debris in the rights-of-way obtained for the Work.
3. All timber of merchantable size shall remain the property of the Owner and shall be trimmed and cut in such lengths as directed and stacked along the edge of the right-of-way.

4. All other material, including trimmings from above, shall be completely disposed of in a satisfactory manner.
- E. Removing and resetting fences:
1. Where existing fences must be removed to permit construction of utilities:
 - a. Remove such fences and, as the Work progresses, reset the fences in their original location and condition.
 - b. Provide temporary fencing or other safeguards as required to prevent stock and cattle from wandering to other lands.
- F. Restoration of disturbed areas:
1. Restore all areas disturbed by, during or as a result of construction activities to their existing or better condition.
 2. Do not interpret this as requiring replacement of trees and undergrowth in undeveloped sections of the rights-of-way.
- G. Minimizing silting and bank erosion during construction:
1. During construction, protective measures shall be taken and maintained to minimize silting and bank erosion of creeks and rivers adjacent to the work being performed during construction.

PART 2 PRODUCTS

2.01 FILL MATERIALS

- A. General Fill: Subsoil excavated on-site.
1. Graded.
 2. Free of lumps larger than three (3) inches, rocks larger than two (2) inches and debris.
 3. Conforming to ASTM D 2487 Group Symbol CL.
- B. Granular Fill - Fill Type No. 57: Coarse aggregate, conforming to State of South Carolina Highway Department standard.
- C. Granular Fill - Gravel: Pit run washed stone; free of shale, clay, friable material and debris.
1. Graded in accordance with ASTM D 2487 Group Symbol GW.
 2. Graded in accordance with ASTM C 136, within the following limits:
 - a. 2 inch sieve: 100 percent passing.
 - b. 1 inch sieve: 95 percent passing.
 - c. 3/4 inch sieve: 95 to 100 percent passing.
 - d. 5/8 inch sieve: 75 to 100 percent passing.

- e. 3/8 inch sieve: 55 to 85 percent passing.
 - f. No. 4 sieve: 35 to 60 percent passing.
 - g. No. 16 sieve: 15 to 35 percent passing.
 - h. No. 40: 10 to 25 percent passing.
 - i. No. 200: 5 to 10 percent passing.
- D. Granular Fill - Pea Gravel: Natural stone; washed, free of clay, shale and organic matter.
- 1. Grade in accordance with ASTM D 2487 Group Symbol GM.
 - 2. Graded in accordance with ASTM C 136, within the following limits:
 - a. Minimum Size: 1/4 inch.
 - b. Maximum Size: 5/8 inch.
- E. Sand: Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials and organic matter.
- 1. Grade in accordance with ASTM D 2487 Group Symbol SW.
 - 2. Graded in accordance with ASTM C 136; within the following limits:
 - a. No. 4 sieve: 100 percent passing.
 - b. No. 14 sieve: 10 to 100 percent passing.
 - c. No. 50 sieve: 5 to 90 percent passing.
 - d. No. 100 sieve: 4 to 30 percent passing.
 - e. No. 200 sieve: 0 percent passing.
- F. Topsoil: Topsoil excavated on-site.
- 1. Select.
 - 2. Graded.
 - 3. Free of roots, rocks larger than 1/2 inch, subsoil, debris, large weeds and foreign matter.
 - 4. Acidity range (pH) of 5.5 to 7.5.
 - 5. Containing a minimum of 4 percent and a maximum of 25 percent inorganic matter.
 - 6. Conforming to ASTM D2487 Group Symbol OH.

2.02 EXCAVATED MATERIALS

- A. Perform all excavation of every description and of whatever substances encountered to depths indicated or specified.
- B. Pile material suitable for backfilling in an orderly manner at safe distance from banks or trenches to avoid overloading and to prevent slides or cave-ins.
- C. Remove and deposit unsuitable or excess materials as directed by the Engineer.

2.03 BACKFILL MATERIALS

- A. Provide from materials excavated for installation of utility.
 - 1. Select soil material free from organic matter and deleterious substances, containing no rocks or lumps over 2-inches in greatest dimension for backfill up to 12-inches above top of utility being covered.
 - 2. Do not permit rocks larger than 2-inches in greatest dimension in top 6-inches of backfill.

2.04 OTHER MATERIALS

- A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.
- B. Should the quantity of suitable on-site material be insufficient to complete the work, provide suitable borrow material as approved by the Engineer at no additional expense to the Owner.
- C. Provide select materials from on-site if acceptable material as approved by the Engineer is available on-site. Otherwise, provide approved select material from an off-site source.

2.05 SOURCE QUALITY CONTROL

- A. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.
- B. If tests indicate materials do not meet specified requirements, change material and retest.
- C. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that survey bench marks and intended elevations for the work are as indicated.

3.02 PREPARATION

- A. Identify required lines, levels, contours and datum locations.
- B. See Section 31 22 00 – Grading for additional requirements.
- C. Locate, identify and protect utilities that remain and protect from damage.

- D. Notify utility company to remove and relocate utilities.
- E. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving and curbs from excavating equipment and vehicular traffic.
- F. Protect plants, lawns, rock outcroppings and other features to remain.

3.03 PROTECTION OF EXISTING UTILITIES AND ADJACENT STRUCTURES

- A. Existing utilities:
 - 1. Unless shown to be removed, protect active utility lines shown on the drawings or otherwise made known to the Contractor prior to trenching. If damaged, repair or replace at no additional cost to the Owner.
 - 2. If active utility lines are encountered and are not shown on the Drawings or otherwise made known to the Contractor, promptly take necessary steps to assure that service is not interrupted.
 - 3. If service is interrupted as a result of work under this Section, immediately restore service by repairing the damaged utility at no additional cost to the Owner.
 - 4. If existing utilities are found to interfere with the permanent facilities being constructed under this Section, immediately notify the Engineer and secure their instructions.
 - 5. Do not proceed with permanent relocation of utilities until written instructions are received from the Engineer.
 - 6. Locations within streets or highways:
 - a. Comply with the South Carolina Department of Transportation's (SCDOT) "Encroachment Permit" issued for the Work and the South Carolina Department of Transportation's (SCDOT) "A Policy for Accommodating Utilities on Highway Rights-of-Way".
 - b. Take all precautions and comply with all requirements as may be necessary to protect the improvements, including barricades for protection of traffic.
 - c. Keep minimum of one lane open to traffic at all times where utility crosses street or highway.
 - 7. Protection of persons and property:
 - a. Barricade open holes and depressions occurring as part of the Work and post warning lights on property adjacent to or with public access.
 - b. Operate warning lights during hours from dusk to dawn each day and as otherwise required.
 - c. Protect structures, utilities, sidewalks, pavements and other facilities from damage caused by settlement, lateral movement, washout and other hazards created by operations under this Section.

8. Dewatering:
 - a. Remove all water, including rain water, encountered during trench and sub-structure work to an approved location by pumps, drains and other approved methods.
 - b. Keep trenches and site construction area free from water.
9. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors and to other work being performed on or near the site.
10. Maintain access to adjacent areas at all times.

3.04 TRENCHING

- A. Notify Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- B. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.
- C. Do not interfere with 45 degree bearing splay of foundations.
- D. Cut trenches wide enough to allow inspection of installed utilities.
- E. Hand trim excavations. Remove loose matter.
- F. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.
- G. Remove lumped subsoil, boulders and rock up to 1/3 cu. yd. measured by volume.
- H. Remove excavated material that is unsuitable for re-use from site.
- I. Stockpile excavated material to be re-used in area designated on site in accordance with Section 31 22 00.
- J. Remove excess excavated material from site.
- K. Trench Excavation:
 1. Remove all materials of whatever substance encountered.
- L. Where trenching occurs in existing lawns, remove turf in sections and keep damp. Replace turf upon completion of the backfilling.
- M. Open cut:
 1. Excavate for utilities by open cut.
 2. If conditions at the site prevent such open cut and if approved by the Engineer, tunneling may be used.
 3. Short sections of a trench may be tunneled if, in the opinion of the Engineer, the conductor can be installed safely and backfill can be compacted properly into such tunnel.

4. Remove boulders and other interfering objects and backfill voids left by such removals, at no additional cost to the Owner.
 5. Remove wet or otherwise unstable soil incapable of properly supporting the utility, as determined by the Engineer, to depth required and backfill to proper grade with stone bedding material, at no additional cost to the Owner.
 6. Excavating for appurtenances:
 - a. Excavate for manholes and similar structures to a distance sufficient to leave at least 12-inches clear between outer surfaces and the embankment or shoring that may be used to hold and protect the banks.
 - b. Overdepth excavation beyond such appurtenances that has not been directed will be considered unauthorized. Fill with sand, gravel, or lean concrete as directed by the Engineer and at no additional cost to the Owner.
- N. Trench to the minimum width necessary for proper installation of the utility, with sides as nearly vertical as possible. Accurately grade the bottom to provide uniform bearing for the utility.
1. Dig to a true grade and to provide a smooth continuous support along the entire length of the pipe line.
 2. Excavate to a width not less than 12 inches greater than the outside diameter of the pipe.
 3. Trench depth shall provide a minimum of 4 feet of cover over the pipe as measured along the pipe centerline.
 4. Where the pipeline crosses creeks, drainage ditches or land subject to flooding, the depth of cover shall be 4' minimum.
 5. Where the pipeline crosses existing gas mains or other utilities, a minimum of 24 inches of separation under the existing utility shall be maintained. Additional depth of excavation as required to maintain separation shall be completed at no additional cost to the Owner.
 6. At any creek, draw, gully, embankment or other place where rough terrain exists, the trench shall be graded to avoid the use of bends or deflections greater than 2-1/2° per joint unless otherwise approved by the Engineer.
 - a. Where changes in direction occur requiring greater than 2-1/2° deflection, field bending of the pipe is to be used with minimum bending radius being no less than 10 times the pipe diameter.
- O. Provide sheeting and shoring necessary for protection of the Work and for the safety of personnel.
1. Remove in units when level of backfilling has reached the elevation necessary to protect the utility work and adjacent property.
 2. Sheeting at the bottom of trenches over 10-feet deep for sewers 15-inches and larger in size, shall remain in place and be cut off no less than 2-inches above top of pipe, at no additional cost to the Owner.

3. When, in the opinion of the Engineer, other sheeting cannot be safely removed, it shall be left in place and the Contractor will be paid for such sheeting at the prices bid.
 - a. Cut such sheeting off at least 2-feet below finished surface.
 - b. No lumber for sheeting or shoring exceeding that size customarily used will be paid for unless the use of larger sizes has been ordered, in writing, by the Engineer.
- P. Depressions:
 1. Dig bell holes and depressions for joints after the trench has been graded. Provide uniform bearing for the pipe on prepared bottom of the trench.
 2. Except where rock is encountered, do not excavate below the depth indicated or specified.
 3. Where rock is encountered, excavate rock to a minimum overdepth of 4-inches below the trench depth indicated or specified and to provide 6-inches clearance in any horizontal direction from all parts of the utility and appurtenances.
- Q. Comply with pertinent OSHA regulations in regards to the excavation of utilities.

3.05 PREPARATION FOR UTILITY PLACEMENT

- A. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.
- B. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- C. Until ready to backfill, maintain excavations and prevent loose soil from falling into excavation.

3.06 BACKFILLING

- A. Backfill to contours and elevations indicated using unfrozen materials.
- B. Backfill trenches and excavations immediately after the pipes are laid, unless other protection is directed or indicated.
- C. Select and deposit backfill materials with special reference to the future safety of the pipes.
- D. Reopen trenches which have been improperly backfilled, to a depth as required for proper compaction. Refill and compact as specified, or otherwise correct to the approval of the Engineer.
- E. Surplus material shall be disposed of as directed by the Engineer.
- F. Original surface shall be restored to the approval of the Engineer.
- G. Fill up to subgrade elevations unless otherwise indicated.
- H. Lower portion of trench:

1. Deposit approved backfill and bedding material in layers of 6-inches maximum thickness and compact with suitable tampers to the density of the adjacent soil until there is a cover of not less than 36-inches over sewers and 12-inches over other utility lines.
 2. Take special care in backfilling and bedding operations not to damage pipe and pipe coatings.
- I. Remainder of trench:
1. Except for special materials for pavements, backfill the remainder of the trench with material free from stones larger than 6-inches or 1/2 the layered thickness, whichever is smaller, in any dimension.
 2. Deposit backfill material in layers not exceeding the thickness specified and compact each layer to the minimum density directed by the soil engineer.
- J. Undeveloped areas:
1. Backfill in wooded, swampy or undeveloped areas shall be as specified hereinbefore, except that tamping of the backfill above a level 2-feet over the top of the pipe will not be required.
 2. Mound excavated material neatly over the ditch to provide for future settlements.
- K. Employ a placement method that does not disturb or damage other work.
- L. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- M. Maintain optimum moisture content of fill materials to attain required compaction density.
- N. Granular Fill: Place and compact materials in equal continuous layers not exceeding 6 inches compacted depth.
- O. Soil Fill: Place and compact material in equal continuous layers not exceeding 8 inches compacted depth.
- P. Slope grade away from building minimum 2 inches in 10 feet, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- Q. Correct areas that are over-excavated.
1. Thrust bearing surfaces: Fill with concrete.
 2. Other areas: Use general fill, flush to required elevation, compacted to minimum 95 percent of maximum dry density.
- R. Compaction Density Unless Otherwise Specified or Indicated:
1. Under paving, slabs-on-grade and similar construction: 100 percent of maximum dry density.
 2. At other locations: 95 percent of maximum dry density.
- S. Reshape and re-compact fills subjected to vehicular traffic.

3.07 BEDDING AND FILL AT SPECIFIC LOCATIONS

- A. Use general fill unless otherwise specified or indicated.
- B. Utility Piping:
 - 1. Bedding: Use general fill.
 - 2. Cover with general fill.
 - 3. Fill up to subgrade elevation.
 - 4. Compact in maximum 8 inch lifts to 95 percent of maximum dry density.
- C. At Pipe Culverts:
 - 1. Bedding: Use general fill.
 - 2. Cover with general fill.
 - 3. Fill up to subgrade elevation.
 - 4. Compact in maximum 8 inch lifts to 95-percent of maximum dry density.

3.08 TOLERANCES

- A. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

3.09 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection and testing.
- B. Perform compaction density testing on compacted fill in accordance with ASTM D1556, ASTM D2167, ASTM D3017, or ASTM D6938.
- C. Perform compaction density testing on compacted fill in accordance with ASTM D1556, ASTM D2167, ASTM D2922, or ASTM D3017.
- D. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D698 ("standard Proctor"), ASTM D1557 ("modified Proctor"), or AASHTO T 180.
- E. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- F. Frequency of Tests:
 - 1. At least one (1) field density test for every fifty (50) linear feet of trench within each lift.

3.10 CLEANING

- A. Leave unused materials in a neat, compact stockpile.
- B. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.
- C. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

END OF SECTION

SECTION 31 23 23.13

BACKFILL AND COMPACTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Filling, backfilling and compacting for structure volume below grade.
- B. Backfilling and compacting for utilities outside the structure to utility main connections.
- C. Filling holes, pits and excavations generated as a result of removal (demolition) operations.

1.02 RELATED SECTIONS

- A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Sections in Division 01 of these Specifications.
- B. Document 02 30 00.10 - Geotechnical Data – Geotechnical Exploration Reports
- C. Section 31 22 00 – Grading.
- D. Section 31 23 16 - Excavation.
- E. Section 31 23 16.13 – Trenching for Site Utilities
- F. Section 31 37 00 - Riprap.
- G. Section 31 25 00 - Erosion and Sedimentation Control.
- H. Section 03 30 00 - Cast-in-Place Concrete.

1.03 REFERENCES

- A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; American Association of State Highway and Transportation Officials; 2001 (2004).
- B. ASTM C 136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2006.
- C. ASTM D 698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)); 2000a.
- D. ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2000.
- E. ASTM D 1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN m/m³)); 2002
- F. ASTM D 2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 1994(R 2001).
- G. ASTM D 2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2006.

- H. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth); 2005.
- I. ASTM D 3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2005.
- J. ASTM D 4318 - Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils; 2005.

1.04 DEFINITIONS

- A. Finish Grade Elevations: Indicated on drawings.
- B. Subgrade Elevations: Indicated on drawings.
- C. Open areas: Open areas shall be those areas that do not include building sites, paved areas, street right-of-way and parking areas.
- D. Maximum density: Maximum weight in pounds per cubic foot of a specific material.
- E. Optimum moisture: Percentage of water in a specific material at maximum density.
- F. Muck: Materials unsuitable for foundation because of organic content, saturation to the extent that it is somewhat fluid and must be moved by dragline, dredge, or other special equipment, are designated as muck. No extra payment will be made for muck removal.
- G. Unsuitable material: Unsuitable material is defined as earth material unsatisfactory for its intended use and as classified by the soils technicians. In addition to organic matter, sod, muck, roots and rubbish, highly plastic clay soils of the CH and MH descriptions and organic soils of the OL and OH descriptions, as defined in the Unified Soil Classification System shall be considered as unsuitable material.
- H. Suitable material: Where the term suitable material is used in specification sections pertaining to earthwork, it means earth or materials designated as being suitable for their intended use by soils technicians or the Engineer. Suitable material shall be designated as meeting the requirements of the Unified Soil Classification System types SW, GW, GC, SC, SM, ML, CI or as designated in these specifications.
- I. Select material: Select material is defined as granular material to be used where indicated on the drawings or where specified herein consisting of soils conforming to the Unified Soil Classification types SW, SM, GW, or GM or as otherwise approved by the Engineer as select fill. Select material shall contain no stones or rubble larger than 1-1/2 inches in diameter.
- J. Crushed stone (gravel): Crushed stone shall be No. 57 aggregate or equal conforming to ASTM C 33.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Samples: 10 lb (4.5 kg) sample of each type of fill; submit in air-tight containers to testing laboratory.
- C. Materials Sources: Submit name of imported materials source.

- D. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- E. Compaction Density Test Reports.

1.06 PROJECT CONDITIONS

- A. Provide sufficient quantities of fill to meet project schedule and requirements. When necessary, store materials on site in advance of need.
- B. When fill materials need to be stored on site, locate stockpiles where indicated.
 - 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
 - 2. Prevent contamination.
 - 3. Protect stockpiles from erosion and deterioration of materials.
- C. Verify that survey bench marks and intended elevations for the Work are as indicated.

1.07 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Comply with requirements of governmental agencies having jurisdiction.
- C. Testing: A testing laboratory, retained by the Contractor and approved by the Owner, will make such tests as are deemed advisable. Test as specified in Section 01 45 29, Testing Laboratory Services.
 - 1. Schedule fill and backfill operations so as to permit a reasonable time for inspection and testing before placing succeeding lifts and keep the laboratory and Engineer informed of progress.
 - 2. Notify the Engineer and allow sufficient time for observation and/or testing of foundation subgrades prior to commencing any work on the exposed excavation.

1.08 JOB CONDITIONS

- A. Comply with pertinent provisions of Section 01 60 00 – Product Requirements.

PART 2 PRODUCTS

2.01 SOIL MATERIAL GENERAL

- A. Soil material used as fill, backfill or subgrade for structures shall consist of suitable material.
 - 1. Provide suitable material free from organic matter and deleterious substances, containing no rocks or lumps over 6 inches in greatest dimension and with not more than 15% of the rocks or lumps larger than 2-1/2 inches in their greatest dimension.
 - 2. Do not permit rocks having a dimension greater than 1 inch in the upper 6 inches of fill or subgrade.

- B. Where select material is indicated on the drawings or specified, use select granular material as defined herein and approved by the Engineer.
- C. Where indicated on the drawings or specified, use gravel or crushed stone as defined herein.
- D. Where indicated on the drawings or otherwise where desired, provide a lean concrete "mud slab" beneath foundations.
- E.
 - 1. Use 2000 psi concrete and a minimum thickness of 2-1/2 inches.
 - 2. With prior approval of the Engineer, a "mud slab" may be substituted for gravel base material except where the gravel base is required for drainage or for use with pressure relief valves.

2.02 FILL MATERIALS

- A. General Fill: Subsoil excavated on-site.
 - 1. Graded.
 - 2. Free of lumps larger than 3 inches (75 mm), rocks larger than 2 inches (50 mm) and debris.
 - 3. Conforming to ASTM D 2487 Group Symbol CL.
- B. Granular Fill- Fill Type #57: Coarse aggregate, conforming to State of South Carolina Highway Department standard.

2.03 SOURCE QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for testing and analysis of soil material.
- B. If tests indicate materials do not meet specified requirements, change material and retest.
- C. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Identify required lines, levels, contours and datum locations.

3.02 PREPARATION

- A. Scarify subgrade surface to a depth of 6 inches (150 mm) to identify soft spots.
- B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.
- C. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- D. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.

3.03 FILLING AND BACKFILLING

- A. Fill to contours and elevations indicated using unfrozen materials.
- B. Employ a placement method that does not disturb or damage other work.
- C. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- D. Maintain optimum moisture content of fill materials to attain required compaction density.
- E. Slope grade away from building minimum 2 inches in 10 ft (50 mm in 3 m), unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- F. Correct areas that are over-excavated.
 - 1. Other areas: Use general fill, flush to required elevation, compacted to minimum 97 percent of maximum dry density.
- G. Compaction Density Unless Otherwise Specified or Indicated.
- H. Reshape and re-compact fills subjected to vehicular traffic.
- I. Use suitable material for all filling and backfilling operations.
- J. Fill under structures: Deposit suitable material in layers not exceeding 8" in depth and compact each layer using proper equipment.
- K.
 - 1. Do not place rock that will not pass through a 6-inch diameter ring within the top 12" of the surface of the completed fill or rock that will not pass through a 3-inch diameter ring within the top 6 inches of the completed fill.
 - 2. Do not place broken concrete, bricks, or asphaltic pavement in fills.
 - 3. Where indicated on the drawings, provide select granular material.
- L. Backfill excavations as promptly as progress of the Work permits, but not until completion of the following:
 - 1. Inspection and acceptance of construction below finish grade including, where applicable, damp proofing and waterproofing.
 - 2. Inspecting, testing, approving and recording locations of underground utilities.
 - 3. Removing concrete formwork.
 - 4. Removing shoring and bracing and backfilling of voids with satisfactory materials.
 - 5. Removing trash and debris.
 - 6. Foundation walls have been in place seven days.
- M. Placing and compacting:
 - 1. Place backfill and fill materials in layers not more than 8 inches in loose depth.

2. Before compacting, moisten or aerate each layer as necessary to provide the optimum moisture content within $\pm 2\%$.
3. Compact each layer to required percentage of maximum density for area.
4. Do not place backfill or fill material on surfaces that are muddy, frozen, or containing frost or ice.
5. Place backfill and fill materials evenly adjacent to structures, to required elevations.
6. Take care to prevent wedging action of backfill against structures by carrying the material uniformly around the structure to approximately the same elevation in each lift.
7. Do not operate heavy equipment closer to foundation or retaining walls than a distance equal to height of backfill above the footing.
 - a. Compact remaining area using power driven hand tampers.
8. Where the construction includes basement or other underground walls having structural floors over them, do not backfill such walls until the structural floors are in place and have attained sufficient strength to support the walls.

3.04 FILL AT SPECIFIC LOCATIONS

A. Over Buried Utility Piping, Conduits and Duct Bank in Trenches:

1. Bedding: Use general fill.
2. Cover with general fill.
3. Fill up to subgrade elevation.
4. Compact in maximum 8 inch (200 mm) lifts to 95 percent of maximum dry density.

B. At Lawn Areas:

1. Use general fill.
2. Fill up to 6 inches (150 mm) below finish grade elevations.
3. Fill up to subgrade elevations.
4. Compact to 95 percent of maximum dry density.
5. See Section 31 22 00 - Grading for topsoil placement.

3.05 COMPACTION REQUIREMENTS

- A. Compact soils to not less than the following percentages of maximum dry density as determined in accordance with ASTM D698, Method A (Standard Proctor).
- B. Existing in place subgrade below structures where subgrade has been disturbed by water, improper dewatering, or construction traffic.
 1. Top 12 inches of subgrade: 100%

2. Below top 12 inches of subgrade: 98%
- C. Fill beneath structures and beneath an area extending 10 feet beyond the limits of the foundation:
1. Top 12 inches of subgrade: 100%
 2. Below top 12 inches of subgrade: 98%
- D. Compaction of suitable material used to replace unsuitable material below foundation subgrades:
1. Top 12 inches of subgrade: 100%
 2. Below top 12 inches of subgrade: 98%

3.06 BACKFILLING, FILLING AND COMPACTION

- A. Use suitable material for all filling and backfilling operations.
- B. Fill under structures: Deposit suitable material in layers not exceeding 8 inches in depth and compact each layer using proper equipment.
1. Do not place rock that will not pass through a 6-inch diameter ring within the top 12 inches of the surface of the completed fill or rock that will not pass through a 3-inch diameter ring within the top 6 inches of the completed fill.
 2. Do not place broken concrete, bricks, or asphaltic pavement in fills.
 3. Where indicated on the drawings, provide select granular material.
- C. Backfill excavations as promptly as progress of the Work permits, but not until completion of the following:
1. Inspection and acceptance of construction below finish grade including, where applicable, damp proofing and waterproofing.
 2. Inspecting, testing, approving and recording locations of underground utilities.
 3. Removing concrete formwork.
 4. Removing shoring and bracing and backfilling of voids with satisfactory materials.
 5. Removing trash and debris.
 6. Foundation walls have been in place seven days.
- D. Placing and compacting:
1. Place backfill and fill materials in layers not more than 8 inches in loose depth.
 2. Before compacting, moisten or aerate each layer as necessary to provide the optimum moisture content within $\pm 2\%$.
 3. Compact each layer to required percentage of maximum density for area.

4. Do not place backfill or fill material on surfaces that are muddy, frozen, or containing frost or ice.
5. Place backfill and fill materials evenly adjacent to structures, to required elevations.
6. Take care to prevent wedging action of backfill against structures by carrying the material uniformly around the structure to approximately the same elevation in each lift.
7. Do not operate heavy equipment closer to foundation or retaining walls than a distance equal to height of backfill above the footing.
 - a. Compact remaining area using power driven hand tampers.
8. Where the construction includes basement or other underground walls having structural floors over them, do not backfill such walls until the structural floors are in place and have attained sufficient strength to support the walls.

3.07 TOLERANCES

- A. Top Surface of General Backfilling: Plus or minus 1 inch (25 mm) from required elevations

3.08 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection and testing.
- B. Secure the Engineer's construction observation and approval of subgrades and fill layers before subsequent construction is permitted thereon.
- C. Perform compaction density testing on compacted fill in accordance with ASTM D1556, ASTM D2167, ASTM D2922, or ASTM D3017.
- D. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D 698 ("standard Proctor"), ASTM D 1557 ("modified Proctor"), or AASHTO T 180.
- E. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- F. Frequency of Tests:
 1. At areas to receive paving, at least one field density test for every 5,000 sq.ft. of subgrade area, but not less than three (3) tests.
 2. In each compacted fill layer, one field density test for every 5,000 sq.ft. of overlaying paved area, but not less than three (3) tests.
 3. In fill beneath structures, one field density test for every 2,500 sq.ft. in each layer.
 4. Other tests as deemed necessary by the Engineer
- G. If, the Engineer's opinion based on reports of the testing laboratory, subgrade or fills that have been placed are below specified density, provide additional compacting and testing until specified requirements are met.

1. Additional testing will be provided by the Owner's selected testing laboratory and all costs for the additional testing will be borne by the Contractor.

H. Proofrolling:

1. Upon request by the Engineer, proofroll the subgrade of structure foundations.
 - a. Make not less than three (3) passes of a 25 to 50 ton rubber tired roller over the full area.
 - b. Unstable, soft or otherwise unsuitable materials revealed by the proofrolling shall be removed and replaced with satisfactory material and compacted as specified herein.

3.09 DEWATERING

- A. Remove all surface and subsurface waters from excavations and maintain the excavation in a dry condition during construction operations.
- B. Maintain the water level below the excavation subgrade during excavation and construction.
 1. Material disturbed below the foundation subgrade due to improper dewatering shall be removed and replaced with crushed stone or lean concrete at no expense to the Owner.
 2. Use sumps, pumps, drains, trenching or well point system as necessary to maintain a dry excavation.
 3. Dewatering by trench pumping will not be permitted if migration of fine grained natural material (running sand) from bottom, side walls or bedding material will occur.
- C. Dispose of water pumped from excavations in storm drains having capacity, canals, trenches or other approved locations.
 1. Contractor is responsible for acquiring all permits required to discharge the water and shall protect waterways from turbidity during the operation.
 2. Prevent flooding of streets, roadways, or private property.
 3. Provide engines driving dewatering pumps with residential type mufflers.

3.10 CLEAN-UP

- A. Leave unused materials in a neat, compact stockpile.
- B. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.
 1. Unstable, soft or otherwise unsuitable materials revealed by the proofrolling shall be removed and replaced with satisfactory material and compacted as specified herein.
- C. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stock

3.11 MEASUREMENT AND PAYMENT

- A. No separate measurement or direct payment will be made for the work under this section and all costs for same shall be included in the lump sum bid.

END OF SECTION

SECTION 31 25 00

EROSION AND SEDIMENTATION CONTROLS

PART 1 GENERAL

1.01 DESCRIPTION

- A. Work included: Implement, Protect, Comply and Enforce the Department of Health and Environmental Control approved construction stormwater pollution prevention plan (C-SWPPP) during the construction of this project to reduce soil erosion and siltation to the lowest reasonably achievable level.

1.02 GENERAL

- A. Exercise every reasonable precaution, throughout the life of the project, to prevent the eroding of soil and the silting of rivers, streams, lakes, reservoirs, other water impoundments, ground or roadway surfaces, or other property. Erosion control practices to be used for this project are shown on the drawings and are to conform to South Carolina Department of Health and Environmental Control regulations.

PART 2 PRODUCTS

2.01 CRUSHED STONE

- A. Provide #57 crushed stone for project entrance and exit.
- B. Provide #57 crushed stone for temporary sediment barriers around inlets and for temporary stone check dams.

2.02 GRASSING

- A. Comply with Section 32 92 00 – Turf and Grasses.

2.03 SILT FENCE

- A. Posts:
 - 1. Posts shall be self-fastener angle steel, 5' in length.
- B. Woven wire shall conform to the requirements of ASTM A 116, Class I zinc coating for wire. Each woven square shall measure 5.33" X 12". The top and bottom wires shall be 10 gauge. All other wires shall be 12-1/2 gauge.
- C. Filter fabric shall be synthetic fabric as manufactured by Celanese Fibers Co., DuPont, Industrial Netting or approved equal.

2.04 EROSION CONTROL BLANKET

- A. Use erosion control blanket S150 if North American Green, or similar products by profile products, or approved equal.

2.05 RIP-RAP

- A. Comply with Section 31 37 00 - Rip-Rap.

2.06 FILTER FABRIC (Temporary Stone Check Dam)

- A. Use Stabilenka Filter Fabric (T-140N), Mirafil (140N) or approved equal.

PART 3 EXECUTION

3.01 GENERAL

- A. Construct and maintain all erosion control measures until the substantial completion of the project.

3.02 TEMPORARY CONSTRUCTION ENTRANCE/EXIT

- A. Construct a gravel area or pad at points where vehicles enter and leave a construction site.
- B. Clear the entrance and exit area of all vegetation, roots and other objectionable material and properly grade and place gravel to the grade and dimensions shown on the plans.
- C. Construct drainage channels to carry water to a sediment trap or other suitable outlet.
- D. Use geotextile fabrics to improve stability of the foundation in locations subject to seepage or high water table.
- E. Maintain the gravel pad in a condition to prevent mud or sediment from leaving the construction site by periodic top dressing with two inches of stone.
- F. After each rainfall, inspect any structure used to trap sediment and clean it out as necessary.
- G. Immediately remove objectionable materials spilled, washed, or tracked onto public roadways.

3.03 TEMPORARY GRASSING

- A. Provide a temporary cover for erosion control on disturbed areas that will remain unstabilized for a period of more than thirty (30) days in accordance with Section 32 92 00 – Turf and Grasses.
- B. This practice applies to cleared areas, diversions, dams, temporary sediment basins, temporary road banks and topsoil stockpiles where vegetation is needed for less than one (1) year.
- C. Provide grassing on slope 5% or greater within fourteen (14) days of disturbance. Comply with Section 32 92 00 – Turf and Grasses.

3.04 SILT FENCE

- A. Provide silt fence barrier where shown on the plans and on utility construction parallel to the disturbed trench where perpendicular sheet flow runoff occurs on disturbed areas with slopes greater than 4%.

- B. Place at the extreme limits of the area to be disturbed as shown on the plans.
- C. Construct temporary sediment barriers of filter fabric, buried at the bottom, stretched and supported by posts and install below small disturbed areas as indicated on the drawings to retain sediment by reducing the flow velocity to allow sediment deposition.
- D. Provide spacing between posts 5'-0" on center, minimum.
- E. Remove sediment deposits prior to reaching one-third height of the fence.
- F. Monitor site frequently and place additional silt fencing should evidence indicate that erosion is about to occur at locations other than those shown on plan.

3.05 INLET PROTECTION

- A. Construct temporary sediment barriers around storm drain curb inlets using block and gravel as indicated on the drawings.
- B. Inspect structure after each rainfall and repair as required.
- C. Remove sediment when trap reaches one-half capacity.
- D. Remove structure when protected areas have been stabilized.

3.06 EROSION CONTROL BLANKET

- A. Provide on areas as shown on the plans or on all embankments with slopes equal to or steeper than 2-1/2:1.

3.07 TEMPORARY STONE CHECK DAMS

- A. Utilize temporary stone check dams as indicated on the plans or directed by Engineer.
- B. Provide temporary stone check dams constructed of both rip-rap and #57 stone, as illustrated on the plans.

3.08 MAINTENANCE

- A. Place all erosion control devices or measures prior to any land disturbing activity within the drainage area they are located.
- B. Periodically check erosion control devices and clean or otherwise remove silt build-up as necessary to maintain them in proper working order.

3.09 REMOVAL

- A. Remove temporary structures after protected areas have been stabilized.

3.10 MEASUREMENT AND PAYMENT

- A. No separate measurement or direct payment will be made for the work under this Section and all costs for same shall be included in the lump sum bid.

END OF SECTION

SECTION 31 37 00

RIPRAP

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Furnishing all labor, materials and equipment and performing all operations in conjunction with placing protective coatings of broken stone in accordance with these specifications and in conformity with the lines, grades and thicknesses shown on the plans or established by the Engineer.

1.02 RELATED REQUIREMENTS

- A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions and Sections in Division 1 of these Specifications.
- B. Section 31 25 00 - Erosion and Sedimentation Control.
- D. Section 31 23 23.13 – Backfill and Compaction.

1.03 QUALITY ASSURANCE

- A. Perform Work in accordance with State of South Carolina Department of Transportation Highways standards.
- B. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- C. Maintain one copy of each document on site.

1.04 SUBMITTALS

- A. Comply with pertinent provisions of Section 01 30 00 – Administrative Requirements.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Riprap: Granite type; broken stone; solid and non-friable; 6 inch minimum size, 12 inch maximum size.
- B. Aggregate: Granular fill as specified in Section 31 23 23.13 – Backfill and Compaction.
- C. Filter Fabric
 - 1. Comply with Section 31 25 00 – Erosion and Sedimentation Control.

PART 3 EXECUTION

3.01 RIP-RAP PLACEMENT

- A. Place riprap at culvert pipe ends, embankment slopes and as indicated.

- B. Where thickness is not shown on the plans, it shall be 12-inches.
- C. The slope upon which this rip-rap is to be placed shall conform with the cross section shown on the plans or as directed by the Engineer.
- D. Properly compact depressions that may be filled in trimming and shaping the slope.
- E. Install filter fabric, lapping sides 12-inches.
- F. Begin placing in a trench at least 2-feet below the toe of the slope.
- G. Firmly imbed against the slope and the adjoining piece with the sides in contact and with broken joints.
- H. Fill the spaces between the larger pieces with spalls of suitable size, thoroughly ram into place.
- I. The finished surface shall present an even, tight surface true to line, grade and section.

3.02 MEASUREMENT AND PAYMENT

- A. No separate measurement or direct payment will be made for the work under this Section and all costs for same shall be included in the price bid for the item to which it pertains.

END OF SECTION

SECTION 31 50 00

EXCAVATION SUPPORT AND PROTECTION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes temporary excavation support and protection systems.
- B. Related Sections:
 - 1. Section 01 50 00 - Temporary Facilities and Controls for temporary utilities and support facilities.

1.03 PERFORMANCE REQUIREMENTS

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

1.04 SUBMITTALS

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

EXCAVATION SUPPORT AND PROTECTION

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

1.05 QUALITY ASSURANCE

- A. Pre-installation Conference: Conduct conference at Project site.
 1. Review methods and procedures related to excavation support and protection system including, but not limited to, the following:
 - a. Geotechnical report.
 - b. Existing utilities and subsurface conditions.
 - c. Proposed excavations.
 - d. Proposed equipment.
 - e. Monitoring of excavation support and protection system.
 - f. Working area location and stability.
 - g. Coordination with waterproofing.
 - h. Abandonment or removal of excavation support and protection system.

1.06 PROJECT CONDITIONS

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

EXCAVATION SUPPORT AND PROTECTION

positions for comparison with original elevations and positions. Promptly notify Engineer if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 PRODUCTS

2.01 MATERIALS

- A. General: Provide materials that are either new or in serviceable condition.
- B. Structural Steel: ASTM A 36, ASTM A 690, or ASTM A 992.
- C. Steel Sheet Piling: ASTM A 328, ASTM A 572, or ASTM A 690; with continuous interlocks.
 - 1. Corners: Site-fabricated mechanical interlock.
- D. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.
- E. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- F. Tiebacks: Steel bars, ASTM A 722.
- G. Tiebacks: Steel strand, ASTM A 416.

PART 3 EXECUTION

3.01 PREPARATION

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

3.02 SOLDIER PILES AND LAGGING

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

3.03 SHEET PILING

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

3.04 TIEBACKS

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

3.05 BRACING

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

3.06 REMOVAL AND REPAIRS

- A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities and utilities.

1. Remove excavation support and protection systems to a minimum depth of 48 inches below overlaying construction and abandon remainder.
 2. Fill voids immediately with approved backfill compacted to density specified in Division 31 Sections.
 3. Repair or replace, as approved by Engineer, adjacent work damaged or displaced by removing excavation support and protection systems.
- B. Leave excavation support and protection systems permanently in place.

3.07 MEASUREMENT AND PAYMENT

- A. No separate measurement or direct payment will be made for the work under this Section and all costs for same shall be included in the price bid for the item to which it pertains.

END OF SECTION

SECTION 32 11 23

AGGREGATE BASE COURSE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Stone Base Course.
- B. Paving aggregates.

1.02 RELATED REQUIREMENTS

- A. Documents affecting work of this Section include, but are not necessarily limited to Sections in Division 1 of these Specifications.
- B. Section 31 22 00 - Grading: Preparation of site for base course.
- C. Section 31 23 23.13 – Backfill and Compaction: Topsoil fill at areas adjacent to aggregate base course.
- D. Section 31 23 16.13 – Trenching for Site Utilities: Compacted fill over utility trenches under base course.
- E. Section 32 13 13 - Bituminous Concrete Paving: Binder and finish asphalt courses.

1.03 REFERENCE STANDARDS

- A. AASHTO M 147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses; American Association of State Highway and Transportation Officials; 1965 (2012).
- B. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; American Association of State Highway and Transportation Officials; 2010
- C. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2006.
- D. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)); 2012.
- E. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2007.
- F. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN m/m³)); 2012.
- G. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2008.
- H. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2011.

- I. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth); 2005.
- J. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2005.
- K. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils; 2010.

1.04 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.05 PRODUCT HANDLING

- A. Comply with pertinent provisions of Section 01 60 00 – Product Requirements.

1.06 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Samples: 10 lb. sample of each type of aggregate; submit in air-tight containers to testing laboratory.
- C. Materials Sources: Submit name of imported materials source.
- D. Aggregate Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- E. Compaction Density Test Reports.

1.07 DELIVERY, STORAGE AND HANDLING

- A. When necessary, store materials on site in advance of need.
- B. Aggregate Storage, General:
 - 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
 - 2. Prevent contamination.
 - 3. Protect stockpiles from erosion and deterioration of materials.
- C. Verify that survey benchmarks and intended elevations for the Work are as indicated.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Coarse Aggregate Type retained on No. 4 sieve: Coarse aggregate, conforming to State of South Carolina Highway Department standards.

1. Furnish a coarse aggregate consisting of hard, durable particles of stone, reasonably free from soft, thin, elongated or laminated pieces and deleterious substances.
 2. Furnish aggregate with an abrasion loss of less than 65% as measured by the Los Angeles Abrasion Test.
- B. Fine Aggregate: Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials and organic matter.
1. Furnish a fine aggregate consisting of material produced by stone crushing operations.
 2. Liquid limit shall not exceed 25 and the plasticity index shall not exceed 6 when tested in accordance with AASH TO T-89 and T-90, respectively.
 3. Grade in accordance with ASTM D2487 Group Symbol SW.
 4. Graded in accordance with ASTM C136; within the following limits:
 - a. No. 4 sieve: 100 percent passing.
 - b. No. 14 sieve: 10 to 100 percent passing.
 - c. No. 50 sieve: 5 to 90 percent passing.
 - d. No. 100 sieve: 4 to 30 percent passing.
 - e. No. 200 sieve: 0 percent passing.
- C. Composite Mixture:
1. Produce in one crushing operation or by blending the fine and coarse aggregate in proper proportions.
 2. Graded in accordance with ASTM C136; within the following limits:
 - a. No. 2-0" Sieve 100 Percent Passing
 - b. No. 1-1/2" Sieve 95-100 Percent Passing
 - c. No. 1-0" Sieve 70-100 Percent Passing
 - d. No. 0-1/2" Sieve 48-75 Percent Passing
 - e. No. 4 Sieve 30-50Percent Passing
 - f. No. 30 Sieve 11-30 Percent Passing
 - g. No. 200 Sieve 0-12 Percent Passing
 - h. Liquid Limit 25 max.
 - i. Plasticity Index 6 max.

- D. Provide Aggregate Type Materials that comply with Section 305 of the South Carolina Department of Transportation Standard Specifications for Highway Construction, Latest Edition.

2.02 SOURCE QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for testing and analysis of aggregate materials.
- B. Where aggregate materials are specified using ASTM D2487 classification, test and analyze samples for compliance before delivery to site.
- C. Where aggregate materials are specified using ASTM D2487 classification, testing of samples for compliance will be provided before delivery to site.
- D. If tests indicate materials do not meet specified requirements, change material and retest.
- E. Provide materials of each type from same source throughout the Work.

2.03 PRIME ASPHALT

- A. Use either MC-30, RC-30, RC-70, or EA-P complying with requirements of Sections 406, 407 and 408 of the South Carolina Department of Transportation specifications.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that survey bench marks and intended elevations for the work are as indicated.
- B. Verify substrate has been inspected, gradients and elevations are correct and is dry.

3.02 PREPARATION

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping and recompacting.
- B. Do not place aggregate on soft, muddy, or frozen surfaces.
- C. Proofroll all areas to receive crushed stone paving.
 - 1. Make not less than three passes over the full area, using a 35 to 50 ton rubber tired roller.
- D. Remove all soft, unstable or unsuitable material that will not compact readily.
 - 1. Remove to full depth of unsuitable material, or to a depth of 30-inches, whichever is less.
 - 2. Replace with satisfactory materials.
- E. Fill all holes, ruts or depressions which develop in the subgrade with approved on-site material, bringing subgrade to indicated line and grades.
- F. Compact subgrade using suitable construction procedures to provide not less than 95% Standard Proctor Maximum Dry Density.

- G. Seal roll the subgrade surface with a steel wheel roller, sealing the surface against excessive water infiltration.
- H. Preparation of Subgrade
 - 1. Proofroll all areas to receive crushed stone paving.
 - a. Make not less than three passes over the full area, using a 35 to 50 ton rubber tired roller.
 - 2. Remove all soft, unstable or unsuitable material that will not compact readily.
 - a. Remove to full depth of unsuitable material, or to a depth of 30-inches, whichever is less.
 - b. Replace with satisfactory materials.
 - 3. Fill all holes, ruts or depressions which develop in the subgrade with approved on-site material, bringing subgrade to indicated line and grades.
 - 4. Compact subgrade using suitable construction procedures to provide not less than 95% Standard Proctor Maximum Dry Density.
 - 5. Seal roll the subgrade surface with a steel wheel roller, sealing the surface against excessive water infiltration.

3.03 INSTALLATION

- A. Spread aggregate over prepared substrate to a total compacted thickness of 6 inches.
- B. Under Bituminous Concrete Paving:
 - 1. Compact to 95 percent of maximum dry density.
- C. Place aggregate in maximum 4-inch layers and roller compact to specified density.
- D. Place aggregates using spreader boxes or other approved spreaders uniformly on one operation.
- E. Take care to avoid segregation of the fine from the coarse aggregate during handling, spreading or shaping operations.
- F. Mix, while at proper moisture, with motor grader or other equipment and maintain to required section and grade until thoroughly compacted.
- G. Level and contour surfaces to elevations and gradients indicated.
- H. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.
- I. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.
- J. Perform using 3-wheel steel wheel roller weighing not less than 10-tons, tandem roller weighing at least 8-tons, or other rollers approved by the Engineer.

- K. Start rolling at edges and proceed toward the center, continue rolling until aggregates are firmly keyed or set.
- L. When initial compaction is completed, should voids remain, place fine aggregates on the surface in an amount only sufficient to fill the voids.
- M. Broom, wet and roll until coarse aggregate is set, bonded and thoroughly compacted for full width and depth.
- N. Use mechanical tamping equipment in areas inaccessible to compaction equipment.
- O. Apply herbicide to finished surface.

3.04 TOLERANCES

- A. Thickness tolerance: Provide the compacted thicknesses shown on the Drawings within a tolerance of minus 1/2-inch.
 - 1. Depth measurements will be made by digging through the base at intervals no closer than 250-feet, nor greater than 500-feet apart.
 - 2. Where thickness is less than depth specified minus 1/2-inch, it shall be corrected as directed by the Engineer.
- B. Variation From Design Elevation: Within 3/8- inch in 10-feet, parallel to the center line of the roadway nor more than 1/2-inch from a template conforming to the cross-sections illustrated on the Construction Plans.
- C. Deviations: Correct by removing materials, replacing with new materials and reworking or recompacting as required.

3.05 FIELD QUALITY CONTROL

- A. Compaction density testing will be performed on compacted aggregate base course in accordance with ASTM D1556.
- B. Compaction density testing will be performed on compacted aggregate base course in accordance with South Carolina Department of Transportation Standard Specifications for Highway Construction, Latest Edition.
- C. Results will be evaluated in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D698 ("standard Proctor").
- D. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- E. Proof roll compacted aggregate at surfaces that will be under slabs-on-grade.
- F. Allow no traffic on surface until mixture has hardened sufficiently to prevent distortion.

3.06 PLACING PRIME COAT

- A. Allow base course to season sufficiently to permit uniform penetration.

- B. Do not apply to wet surfaces or when the temperature is below 60°F in the shade and falling, or below 55°F in the shade and rising.
- C. Clean surfaces of all dust, dirt, clay, etc. using mechanical brooms, etc.
- D. Apply prime material, using pneumatic mounted distributors, at a rate of 0.25 to 0.30 gallon per square yard.
- E. Permit no traffic on primed surfaces until bituminous material has penetrated and dried sufficiently that it does not pick up under traffic.

3.07 CLEANING

- A. Leave unused materials in a neat, compact stockpile.
- B. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.
- C. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.
- D. Allow no traffic on surface until mixture has hardened sufficiently to prevent distortion.

END OF SECTION

SECTION 32 13 13

BITUMINOUS CONCRETE PAVING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aggregate base course.
- B. Single course asphaltic concrete paving.
- C. Double course bituminous concrete paving.
- D. Surface sealer.

1.02 RELATED REQUIREMENTS

- A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, and Sections in Division 1 of these Specifications.
- B. Section 31 22 00 - Grading.
- C. Section 31 23 23.13 – Backfill and Compaction.
- D. Section 32 11 23 - Aggregate Base Course.

1.03 REFERENCE STANDARDS

- A. AI MS-2 - Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types; The Asphalt Institute; 1997.
- B. AI MS-19 - A Basic Asphalt Emulsion Manual; The Asphalt Institute; Fourth Edition.
- C. ASTM D946 - Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction; 2009a.

1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with State of South Carolina Department of Transportation Highways standard.
- B. Mixing Plant: Conform to State of South Carolina Department of Transportation Highways standard.
- C. Obtain materials from same source throughout.
- D. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.05 REGULATORY REQUIREMENTS

- A. Conform to applicable code for paving work on public property.

1.06 SUBMITTALS

- A. Comply with pertinent provisions of Section 01 30 00 – Administrative Requirements.
- B. Product data: Within fourteen (14) calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
 - 1. Materials list of items proposed to be provided under this Section.
 - 2. Certificates, signed by the materials producer and the asphalt paving Subcontractor, stating that materials meet or exceed the specified requirements.

1.07 PRODUCT HANDLING

- A. Comply with pertinent provisions of Section 01 60 00 – Product Requirements.

1.08 FIELD CONDITIONS

- A. Do not place asphalt when ambient air or base surface temperature is less than 40 degrees F in the shade and falling, or below 35°F in the shade and rising, or if surface is wet or frozen.
- B. Place bitumen mixture when temperature is not more than 15 F degrees below bitumen supplier's bill of lading and not more than maximum specified temperature.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Asphalt Cement: ASTM D946.
- B. All Materials: In accordance with State of South Carolina Department of Transportation Highways standards.
- C. All Materials: In accordance with State of South Carolina Department of Transportation Standard Specifications for Highway Construction, latest Edition.
- D. Aggregate for Base Course: Angular crushed washed stone; free of shale, clay, friable material and debris.
 - 1. Graded in accordance with ASTM D2487 Group Symbol GW.
 - 2. Graded in accordance with ASTM C136, within the following limits:
 - a. 2 inch sieve: 100 percent passing.
 - b. 1 inch sieve: 95 percent passing.
 - c. 3/4 inch sieve: 95 to 100 percent passing.
 - d. 5/8 inch sieve: 75 to 100 percent passing.
 - e. 3/8 inch sieve: 55 to 85 percent passing.
 - f. No. 4 sieve: 35 to 60 percent passing.

- g. No. 16 sieve: 15 to 35 percent passing.
 - h. No. 40: 10 to 25 percent passing.
 - i. No. 200: 5 to 10 percent passing.
- E. Aggregate for Binder Course: Angular crushed washed stone; free of shale, clay, friable material and debris.
 - 1. Graded in accordance with ASTM D2487 Group Symbol GW.
 - 2. Graded in accordance with ASTM C136, within the following limits:
 - a. 2 inch sieve: 100 percent passing.
 - b. 1 inch sieve: 95 percent passing.
 - c. 3/4 inch sieve: 95 to 100 percent passing.
 - d. 5/8 inch sieve: 75 to 100 percent passing.
 - e. 3/8 inch sieve: 55 to 85 percent passing.
 - f. No. 4 sieve: 35 to 60 percent passing.
 - g. No. 16 sieve: 15 to 35 percent passing.
 - h. No. 40: 10 to 25 percent passing.
 - i. No. 200: 5 to 10 percent passing.
- F. Fine Aggregate: In accordance with State of South Carolina Department of Transportation Highways standards.
- G. Mineral Filler: Finely ground particles of limestone, hydrated lime or other mineral dust, free of foreign matter.
- H. Primer: In accordance with State of South Carolina Department of Transportation Highways standards.
- I. Tack Coat: Homogeneous, medium curing, liquid asphalt.

2.02 ASPHALT PAVING MIXES AND MIX DESIGN

- A. Use dry material to avoid foaming. Mix uniformly.
- B. Base Course: 3.0 to 6 percent of asphalt cement by weight in mixture in accordance with AI MS-2.
- C. Binder Course: 4.5 to 6 percent of asphalt cement by weight in mixture in accordance with AI MS-2.
- D. Submit proposed mix design of each class of mix for review prior to beginning of work.

2.03 ASPHALTIC CONCRETE MIXTURE (BINDER COURSE)

- A. Materials and composition of mixture shall comply with Section 402 of the SCDOT's "Standard Specifications for Type 1 Mix".
- B. Provide hot plant mixed asphaltic concrete paving materials.
 - 1. Temperature leaving the plant: 290°F minimum, 320°F maximum.
 - 2. Temperature at time of placing: 280°F minimum.

2.04 ASPHALTIC CONCRETE MIXTURE (SURFACE COURSE)

- A. Materials and composition of mixture shall comply with Section 403 of the SCDOT's "Standard Specifications for Type B Mix."
- B. Provide hot plant mixed asphaltic concrete paving materials.
 - 1. Temperature leaving the plant: 290°F minimum, 320°F maximum.
 - 2. Temperature at time of placing: 280°F minimum.

2.05 EQUIPMENT

- A. Comply with requirements of Section 401 of SCDOT's "Standard Specifications".

2.06 SOURCE QUALITY CONTROL

- A. Test mix design and samples in accordance with AI MS-2.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that compacted subgrade is dry and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.

3.02 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.
 - 1. Sweep primed surfaces if needed.
 - 2. Adjust frames and covers if needed.

3.03 BASE COURSE

- A. Place and compact base course.
- B. On arrival at point of use, dump directly into mechanical spreader.

- C. Immediately spread and strike off true to the line, grade and cross section indicated, to such loose depth that when work is completed, the indicated thickness or weight per square yard will be secured.
- D. Correct irregularities while the mixture is still hot.
- E. At locations not readily accessible to mechanical spreaders, acceptable hand spreading methods may be used.
- F. Finished surfaces placed adjacent to curbs, gutters, manholes, etc., shall be approximately 1/4-inch above the edges of these structures.
- G. Section 32 11 23 - Aggregate Base Course.

3.04 COMPACTION

- A. Perform initial rolling with 3-wheel steel roller or a steel wheel 2-axle tandem roller.
- B. Follow initial rolling with at least four complete coverages by a pneumatic tired roller.
- C. Complete rolling with steel wheel 2-axle tandem roller.
- D. Rolling shall start longitudinally at the sides and proceed gradually toward the center of the pavement, overlapping on successive trips approximately 1/2 the width of the roller.
- E. Use hand or mechanical tampers in areas not accessible to powered rollers.
- F. Surface mixture after compaction shall be smooth and true to the established crown and grade.

3.05 PREPARATION – PRIMER

- A. Apply primer in accordance with manufacturer's instructions.
- B. Apply primer on aggregate base or sub-base at uniform rate of 1/3 gal/sq yd.
- C. Use clean sand to blot excess primer.

3.06 PREPARATION - TACK COAT

- A. Apply tack coat in accordance with manufacturer's instructions.
- B. Apply tack coat on asphalt or concrete surfaces over subgrade surface at uniform rate of 1/3 gal/sq yd.
- C. Apply tack coat to contact surfaces as required.
- D. Coat surfaces of manhole frames with oil to prevent bond with asphalt pavement. Do not tack coat these surfaces.

3.07 SEAL COAT

- A. Apply seal coat to surface course and asphalt curbs in accordance with AI MS-19.

3.08 TOLERANCES

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

- B. Compacted Thickness: Within 1/4 inch of specified or indicated thickness.
- C. Variation from True Elevation: Within 1/8 inch, in 6-feet.
- D. Free from Bird Baths.

3.09 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for quality control.
- B. Provide field inspection and testing. Take samples and perform tests in accordance with AI MS-2.
- C. Flood Test
 - 1. Flood the entire asphaltic concrete paved area with water by use of a tank truck or hoses.
 - 2. If a depression is found where water ponds to a depth of more than 1/8-inch in 6-feet, fill or otherwise correct to provide proper drainage.
 - 3. Feather and smooth the edges of fill so that the joint between fill and original surface is invisible.

3.10 PROTECTION

- A. Allow no traffic on surface until the mixture has hardened sufficiently to prevent distortion.

3.11 SCHEDULE

- A. Pavement at Truck Ramp and Garbage Area: Single course of 3-1/2 inch compacted thickness, sand seal coat.
- B. Pavement at Parking Areas: Two courses; binder course of 2-1/2 inch compacted thickness and wearing course of 1 inch compacted thickness, fog seal coat.
- C. Pavement at Rear Bus Loading Area: Thickness and compaction of subbase to support vehicles up to 30,000 lb.
- D. Pavement Front Sidewalks: Thickness and compaction of subbase to support moderate pedestrian traffic.

END OF SECTION

SECTION 32 31 13

CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fence framework, fabric and accessories.
- B. Excavation for post bases; concrete foundation for posts.
- C. Manual gates and related hardware.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete anchorage for posts.

1.03 REFERENCE STANDARDS

- A. ASTM A121 - Standard Specification for Metallic-Coated Carbon Steel Barbed Wire; 2013.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2012.
- C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- D. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric; 2011a.
- E. ASTM F567 - Standard Practice for Installation of Chain-Link Fence; 2011.
- F. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures; 2010.
- G. CLFMI CLF 2445 - Product Manual; Chain Link Fence Manufacturers Institute; 1997.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on fabric, posts, accessories, fittings and hardware.
- C. Project Record Documents: Accurately record actual locations of property perimeter posts relative to property lines and easements.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section.

PART 2 PRODUCTS

2.01 MATERIALS AND COMPONENTS

- A. Materials and Components: Conform to CLFMI Product Manual.
- B. Fabric Size: CLFMI Heavy Industrial service.
- C. Intermediate Posts: Type I round.
- D. Terminal, Corner, Rail, Brace and Gate Posts: Type I round.

2.02 MATERIALS

- A. Posts, Rails and Frames: ASTM F1083 Schedule 40 hot-dipped galvanized steel pipe, welded construction, minimum yield strength of 30 ksi (205 MPa).
- B. Wire Fabric: ASTM A392 zinc coated steel chain link fabric.
- C. Barbed Wire: Zinc-coated steel, complying with ASTM A121 Type Z Coating Class 1; three strands of 0.099 inch (2.51 mm) diameter wire, with 2-pointed barbs at 4 inches (102 mm) on center.
- D. Concrete: Type specified in Section 03 30 00 – Cast-in-Place Concrete.

2.03 COMPONENTS

- A. Line Posts: 1.9 inch (48 mm) diameter.
- B. Corner and Terminal Posts: 2.38 inch (60 mm).
- C. Gate Posts: 3.5 inch (89 mm) diameter.
- D. Top and Brace Rail: 1.66 inch (42 mm) diameter, plain end, sleeve coupled.
- E. Gate Frame: 1.66 inch (42 mm) diameter for welded fabrication.
- F. Fabric: 2 inch (51 mm) diamond mesh interwoven wire, 6 gage (5 mm) thick, top selvage knuckle end closed, bottom selvage twisted tight.
- G. Tension Wire: 6 gage (5 mm) thick steel, single strand.
- H. Tie Wire: Aluminum alloy steel wire.

2.04 ACCESSORIES

- A. Caps: Cast steel galvanized; sized to post diameter, set screw retainer.
- B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; steel.
- C. Extension Arms: Cast steel galvanized, to accommodate 3 strands of barbed wire, single arm, vertical.
- D. Hardware for Double Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches (1525 mm) high, 3 for taller gates; drop bolt on inactive leaf engaging socket stop set in concrete,

active leaf latched to inactive leaf preventing raising of drop bolt, padlock hasp; keepers to hold gate in fully open position.

2.05 FINISHES

- A. Components (Other than Fabric): Galvanized in accordance with ASTM A123/A123M, at 1.7 oz/sq ft (530 g/sq m).
- B. Hardware: Hot-dip galvanized to weight required by ASTM A153/A153M.
- C. Accessories: Same finish as framing.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install framework, fabric, accessories and gates in accordance with ASTM F567.
- B. Place fabric on outside of posts and rails.
- C. Set intermediate posts plumb, in concrete footings with top of footing 2 inches above finish grade. Slope top of concrete for water runoff.
- D. Line Post Footing Depth Below Finish Grade: ASTM F567.
- E. Corner, Gate and Terminal Post Footing Depth Below Finish Grade: ASTM F567.
- F. Brace each gate and corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail one bay from end and gate posts.
- G. Provide top rail through line post tops and splice with 6 inch (150 mm) long rail sleeves.
- H. Install center brace rail on corner gate leaves.
- I. Position bottom of fabric 2 inches (50 mm) above finished grade.
- J. Fasten fabric to top rail, line posts, braces and bottom tension wire with tie wire at maximum 15 inches (380 mm) on centers.
- K. Attach fabric to end, corner and gate posts with tension bars and tension bar clips.
- L. Install bottom tension wire stretched taut between terminal posts.
- M. Install support arms sloped inward and attach barbed wire; tension and secure.
- N. Install gate with fabric and barbed wire overhang to match fence. Install hardware.
- O. Provide concrete center drop to footing depth and drop rod retainers at center of double gate openings.

END OF SECTION

SECTION 32 92 00
TURF AND GRASSES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Seeding and Fertilization
- B. Provide grassing for the area specified herein, or as indicated, for a complete and proper installation.
- C. Water and sanitary sewer easements, including highway and street shoulders: All areas disturbed by the construction process.

1.02 RELATED REQUIREMENTS

- A. Documents affecting work in this section include, but are not necessarily limited to, General Conditions, and Sections in Division 1 of these Specifications.
- B. Section 31 23 23.13 – Backfill and Compaction
- C. Section 31 25 00 – Erosion and Sedimentation Control

1.03 DEFINITIONS

- A. Weeds: Include Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Johnsongrass, Poison Ivy, Nut Sedge, Nimble Will, Blindweed, Bentgrass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.04 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Seed: Conform to all State laws and to all requirements and regulations of the South Carolina Department of Agriculture.
 - 1. Deliver to site each variety of seed individually packaged and tagged to show name, net weight, origin, and lot number.
- C. Fertilizer: Conform to State fertilizer law.

1.05 SUBMITTALS

- A. See Section 01 30 00 – Administrative Requirements, for submittal procedures.
- B. Comply with pertinent provisions of Section 01 30 00 – Administrative Requirements.
- C. Product Data: Within 15 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:

1. Complete materials list of items proposed to be provided under this Section.
2. Material Safety Data Sheets for all materials to be used.
3. Installation/Application Instructions for all relevant materials (i.e. erosion blankets, hydraulic mulches)

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable. Deliver seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.
- B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.
- C. Comply with pertinent provisions of Section 01 60 00 – Produce Requirements
- D. At time of delivery, furnish the Engineer invoices of all materials received in order that application rates may be determined.
- E. Immediately remove from the site materials that do not comply with the specified requirements, and promptly replace with materials meeting the specified requirements.

PART 2 PRODUCTS

2.01 GRASS SEED

- A. Provide grass seed that is:
 1. Free from noxious weed seeds
 2. Current year crop seed
 3. Treated with appropriate fungicide at time of mixing
 4. Delivered to the site in sealed containers with dealer's guaranteed analysis
- B. Water: Clean, fresh and free of substances that could inhibit vigorous growth of grass.
- C. Stakes: Softwood lumber, chisel pointed
- D. String: inorganic fiber
- E. Lime and pH Adjustment
 1. For Dry Seeding operations provide agricultural grade, standard ground limestone conforming to the current "Rules, Regulations and Standards of the Fertilizer Board of Control" issued at Clemson University.
 2. For Hydraulic Seeding operations, provide NeutralLime Dry by Profile Products or approved equal to raise pH or Aqua-pHix by Profile Products or approved equal to lower pH at rate determined by soil analysis or at manufacturer's recommended rate.

3. Bag tags or delivery slip for bulk loads shall indicate brand or trade name, calcium carbonate equivalent, and other pertinent data to identify the lime.
- F. Wood Fiber Mulch
1. Provide 100% thermally processed wood fiber or blended 70/30 wood/cellulose fiber manufactured specifically for discharging uniformly on the ground surface when dispersed by a hydro-seeding machine.
 2. Material shall contain thermally processed wood fibers so as to contain no germination or growth inhibiting factors and to achieve phyto-sanitization.
 3. Material shall contain basic green dye to facilitate visual metering.
- G. Flexterra HP-FGM or approved equal
1. Provide Flexterra HP-FGM as manufactured by Profile Products or approved equal.
 2. Material shall contain thermally refined wood fibers and crimped synthetic fibers so as to contain no germination or growth inhibiting factors.
 3. Materials shall contain non-toxic green dye to facilitate metering.
 4. Material shall be 100% Bio-degradable.
- H. Straw Mulch/Dry Applied Mulching Pellets
1. Provide straw or hay material.
 - a. Straw to be stalks of wheat, rye, barley or oats.
 - b. Hay to be timothy, peavine, alfalfa, or coastal Bermuda
 2. Material to be reasonably dry and reasonably free from mature seed bearing stalks, roots, or bulblets or Johnson Grass, Nutgrass, Wild Onion or any other Noxious weeds detailed in part 1.04 of this Section.
 3. Seed Aide Aero® manufactured by Profile Products or approved equal at a rate of 3,000 LBS/ACRE can be used as a weed free alternative to straw mulch.
- I. Erosion Control Blanket
1. Provide on areas as shown on the plans
 2. Provide Erosion Control Blanket S-2, from Western Excelsior, or approved equal.

2.02 TESTS

- A. Provide analysis of topsoil fill under provisions of Section 01 40 00 – Quality Requirements
- B. Analyze to ascertain the percentage of nitrogen, phosphorus, potash, soluble salt content, organic matter, and pH value.

- C. Submit minimum 10 oz (280 g) sample of topsoil proposed. Forward sample to approved testing laboratory in sealed containers to prevent contamination.
- D. Testing is not required if recent test are available for imported topsoil. Submit these test results to the testing laboratory for approval. Indicate, by test results, information necessary to determine suitability.
- E. If pH is not in the range of 6.0 to 7.0, adjust accordingly with Lime.
- F. Organic matter must be 2.0% or greater. If organic matter percentage is less than 2%, contractor shall apply JumpStart or approved equal and/or BioPrime by Profile Products or approved equal to modify soil organic matter. JumpStart or approved equal and BioPrime or approved equal to be applied at rate determined by soil analysis or at manufacturer's recommended rate

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that prepared soil base is ready to receive the work of this Section.

3.02 PREPARATION

- A. Seed these areas immediately upon completion of grading or construction and cleanup operations.
 - 1. Slopes greater than 4:1
 - 2. Utility right-of-ways or any other disturbed area adjacent to wetlands.
- B. Bring all areas to proper line, grade and cross section indicated on the plans.
- C. Repair erosion damage prior to commencing seeding operations.
- D. Loosen seed bed to a minimum depth of 3" and track in slope so as the direction of the track marks is perpendicular to the direction of the slope.
- E. Ensure a minimum of 2-inches of topsoil exists in areas to be seeded.
- F. Remove all roots, clods, stones larger than 1" in any dimension, and other debris.

3.03 FERTILIZATION

- A. Apply fertilizer in accordance with manufacturer's instructions and the Soil Analyses as detailed in part 2.03 of this Section.
- B. Apply after smooth raking of topsoil and prior to roller compaction.
- C. Mix thoroughly into upper 2 inches (50 mm) of topsoil.
- D. If seeding using a hydro-seeder apply fertilizer in slurry with mulch, seed, and lime.
- E. Spread uniformly over areas to be seeded at:
 - 1. Rate of 11 LBS/1000 sq. ft. when using 19-19-19.

2. Rate of 20 LBS/1000 sq. ft. when using 10-10-10.
 3. Use approved mechanical spreaders for dry seeding application.
- F. Second Application of Fertilizer
1. When plants are established and showing satisfactory growth, apply Nitrogen at the rate of 1 lb. per 1000 sq. ft.
 2. Apply using dry seeding application unless otherwise directed by Engineer.
 3. Do not apply to stands of temporary grasses.

3.04 SEEDING

- A. Mixtures of different types of seed for the various schedules shall be weighted and mixed in proper proportions in the presence of the Engineer.
- B. Permanent Seeding Mix – Slopes 4:1 or Greater
1. Schedule No. 1 – Planting Dates April 1 – September 15:
 - a. Slopemaster Spring/Summer Mix by Pennington Seed, Inc. or approved equal.
 25% Hulled Sahara Bermudagrass
 25% Unhulled Sahara Bermudagrass
 25% Pensacola Bahiagrass
 10% Durana White Clover
 10% Brown Top Millet
 5% Weeping Lovegrass
 - b. Rate 75 LBS/ACRE or 1.75 LBS/1000 sq. ft.
 - c. Seed to be coated with MYCO Advantage by Pennington Seed, Inc. or approved equal.
 2. Schedule No. 2 – Planting Dates September 15 – March 31:
 - a. Slopemaster Fall/Winter Mix by Pennington Seed, Inc. or approved equal.
 25% Unhulled Sericea Lespedeza
 20% Unhulled Sahara Bermudagrass
 20% Greystone Tall Fescue
 10% Pensacola Bahiagrass
 10% Durana White Clover
 10% Rye Grain
 5% Weeping Lovegrass
 - b. Rate 100 LBS/ACRE or 2.25 LBS/1000 sq. ft.
 - c. Seed to be coated with MYCO Advantage by Pennington Seed, Inc. or approved equal.

- C. Permanent Seeding Mix – Slopes 4:1 or Less
 - 1. Schedule No. 1 – Planting Dates April 1 – September 15:
 - a. Hulled Sahara Bermudagrass
 - b. Rate 75 LBS/ACRE or 1.75 LBS/1000 sq. ft.
 - 2. Schedule No. 2 – Planting Dates September 15 – March 31:
 - a. Unhulled Sahara Bermudagrass
 - b. Rate 100 LBS/ACRE or 2.25 LBS/1000 sq. ft.
- D. Temporary Seeding Mix – All Disturbed Areas
 - 1. Schedule No. 1 – Planting Dates April 1 – September 15:
 - a. Brown Top Millet
Rate 45 LBS/ACRE or 1 LBS/1000 sq. ft.
 - 2. Schedule No. 2 – Planting Dates September 15 – March 31:
 - a. Rye Grain
Rate 80 LBS/ACRE or 2 LBS/1000 sq. ft.
- E. Do not seed areas in excess of that which can be mulched on same day.
- F. Do not sow during rain, when the ground is too dry, or during windy periods.
- G. Immediately following seeding and compacting, apply mulch to a thickness of 1/8 inches (3 mm). Maintain clear of shrubs and trees.
- H. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches (100 mm) of soil.
- I. Following germination, immediately re-seed areas without germinated seeds that are larger than 4 by 4 inches (100 mm by 100mm).

3.05 SOWING METHODS

- A. General:
 - 1. Perform seeding during the periods and at the rates specified in the seeding schedules.
 - 2. Do not conduct seeding work when ground is frozen or excessively wet.
 - 3. Produce satisfactory stand of grass regardless of period of the year the Work is performed.

- B. Seeding, slopes less than four horizontal to one vertical:
1. Seeding of slopes of 4:1 or less will be done in one of the following two ways:
 2. Dry Seeding:
 - a. Sow seed not more than 24 hours after application of fertilizer and lime.
 - b. Use mechanical seed drills on accessible areas, rotary hand seeders, power sprayers, etc. may be used on steep slopes or areas not accessible to seed drills.
 - c. Cover seed and lightly compact with culti-packer if seed drill does not.
 - d. Within 24 hours following compaction of seeded areas, uniformly apply straw mulch, as defined in Section 2.01, at a rate of 4000 LBS/ACRE or 90 LBS/1000 sq. ft.
 3. Hydraulic Seeding:
 - a. Apply seed, fertilizer, lime, and wood fiber mulch using hydraulic equipment.
 - b. Equipment to have built-in agitation system with capacity to agitate, suspend and homogeneously mix a slurry of the specified amount of fiber, fertilizer, seed, lime, and water.
 - c. Minimum capacity of slurry tank: 1000 gallons.
 - d. Apply 100% wood or 70/30 wood/cellulose blend fiber mulch, defined in Section 2.01, at a rate of 2500 LBS/ACRE or 60 LBS/1000 sq. ft.
 - e. Regulate slurry mixture so that amounts and rates of application will result in uniform application of all materials at not less than the specified amounts.
 - f. Apply slurry in two directions so as to avoid "shadowing."
 - g. Use color of fiber mulch as guide, spraying the prepared seed bed until a uniform visible coat is obtained.
- C. Seeding, slopes greater than four horizontal to one vertical:
1. Seeding of slopes of 4:1 or greater will be done in one of the following two ways
 2. Dry Seeding:
 - a. Sow seed not more than 24 hours after application of fertilizer and lime.
 - b. Use mechanical seed drills on accessible areas, rotary hand seeders, power sprayers, etc. may be used on steep slopes or areas not accessible to seed drills.
 - c. Cover seed and lightly compact with culti-packer if seed drill does not.

- d. Within 24 hours following compaction of seeded areas, uniformly lay double netted excelsior blanket, as defined in Section 2.01, over seeded areas. Excelsior blanket installation and staple pattern shall conform strictly to manufacturer's instructions.

3. Hydraulic Seeding:

- a. Apply seed, fertilizer, lime, and Flexterra HP-FGM or approved equal mulch using hydraulic equipment.
- b. Equipment to have built-in agitation system with capacity to agitate, suspend and homogeneously mix a slurry of the specified amount of fiber, fertilizer, seed, lime, and water.
- c. Minimum capacity of slurry tank: 1000 gallons.
- d. Apply Flexterra HP FGM or approved equal, as defined in Section 2.01, at a rate of 3000 LBS/ACRE or 68 LBS/1000 sq. ft.
- e. Regulate slurry mixture so that amounts and rates of application will result in uniform application of all materials at not less than the specified amounts.
- f. Apply slurry in two directions so as to avoid "shadowing."
- g. Use color of fiber mulch as guide, spraying the prepared seed bed until a uniform visible coat is obtained.

3.06 MAINTENANCE

- A. Water to prevent grass and soil from drying out.
- B. Roll surface to remove minor depressions or irregularities.
- C. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions.
- D. Remedy damage resulting from improper use of herbicides.
- E. Areas not showing satisfactory evidence of germination within six weeks of the seeding or which show bare spots, shall be immediately reseeded, fertilized and/or mulched.
- F. Protect seeded areas with warning signs during maintenance period.
- G. Maintain all seeded areas in satisfactory condition until final acceptance of Work.
- H. Repair any eroded areas.
- I. Mow as necessary to maintain healthy growth rate until final acceptance of the Work.

3.07 ACCEPTANCE

- A. Permanently seeded areas will be accepted when the stand of grass reaches 70% coverage.
- B. No acceptance will be made of temporary seeded areas.

3.08 MEASUREMENT AND PAYMENT

- A. No separate measurement or direct payment will be made for the work under this Section and all costs for same shall be included in the price bid for the item to which it pertains.

END OF SECTION

SECTION 33 11 13.14

DUCTILE IRON PIPE

PART 1 GENERAL

1.01 SCOPE

- A. Provide all labor, materials, equipment and incidentals necessary to construct and disinfect, if required, all ductile iron pipe and appurtenances located inside and under buildings and structures, and test as shown on the Drawings and as specified herein.

Ductile iron pipe and appurtenances covered under this Section shall include all interior pipe and accessories to the outside face of structures and buildings, except where there is no joint at the outside face. Where there is no joint at the exterior face, this Section shall include all ductile iron pipe and accessories within two feet of the exterior face of the structure or building.

This Section includes piping and fittings in utility vaults and manholes.

1.02 SUBMITTALS

- A. Complete shop drawings and product data on all piping and fittings shall be submitted to the Engineer in accordance with the requirements of Section 01 30 00 of these Specifications.
- B. Shop drawings shall indicate piping layout in plan and/or elevations and shall include a complete schedule of all pipe, fittings, specials, hangers and supports. Special castings shall be detailed showing all pertinent dimensions. Special coatings shall be clearly identified.
- C. The Contractor shall furnish the Inspector with lists of all pieces of pipe and fittings in each shipment received. These lists shall give the serial or mark number, weight, class, size and description of each item received.
- D. The Contractor shall submit written evidence to the Engineer that the products furnished under this Section will conform to the material and mechanical requirements specified herein. Certified copies of independent laboratory test results or mill test results from the pipe supplier may be considered evidence of compliance provided such tests are performed in accordance with the appropriate testing standards by experienced, competent personnel. In case of doubt as to the accuracy or adequacy of mill tests, the Engineer may require that the Contractor furnish test reports from an independent testing laboratory on samples of pipe materials.

PART 2 PRODUCTS

2.01 DUCTILE IRON PIPE (DIP)

Ductile iron pipe shall be manufactured in accordance with AWWA C115. All pipe, except specials, shall be furnished in nominal lengths of 18 to 20 feet. Sizes will be as shown on the Drawings. All pipe shall have a minimum pressure rating as indicated in the following table, and corresponding minimum wall thickness, unless otherwise specified or shown on the Drawings:

Pipe Sizes (inches)	Special Thickness Class
4 - 54 Flanged	53
4 - 16 Grooved	53
18 Grooved	54
24 - 30 Grooved	56

2.02 FITTINGS AND ACCESSORIES

- A. Fittings, 48-inches and smaller, shall be ductile iron and shall conform to AWWA C110/ANSI A21.10 with a minimum rated working pressure of 250 psi. Fittings, 54 inches and larger, shall be ductile iron and shall conform to AWWA C153/ANSI A15.30 and shall have a minimum rated working pressure of 150 psi. AWWA C153 compact ductile fittings in sizes 4" through 36" are an acceptable substitute unless otherwise specified.
- B. Flanged elbow fittings shall be ANSI pattern using short radius elbows except where noted differently on the Drawings. Special fittings, ductile iron wall pipes and sleeves shall conform to the dimensions and details as shown on the Drawings.
- C. Thrust Collars: Thrust collars shall be welded-on ductile iron body type capable of withstanding a thrust due to 250 psi internal pressure on a dead end from either direction on that pipe size. The welded-on collars shall be continuously welded to the pipe by the pipe manufacturer.
- D. Solid sleeves shall permit the connection of plain end ductile iron pipe. Solid sleeves shall meet the requirements of ANSI/AWWA C110 for long pattern and have a minimum pressure rating of 250 psi. Solid sleeves shall have mechanical or restrained joints as specified in this Section and as shown on the Drawings. Solid sleeves shall be used only in locations shown on the Drawings or at the direction of the Engineer. Solid sleeves shall be manufactured by ACIPCO, U.S. Pipe or McWane (Clow).
- E. Tapping Saddles: Tapping saddles shall be ductile iron body type with O-ring gasket and alloy steel straps. Connection shall be flanged or mechanical joint as detailed on the Drawings. Tapping saddles shall be equal to ACIPCO A-10920 (mechanical joint) or ACIPCO A-30920 (flange joint).
- F. Flange Adapter Coupling: The flange adapter coupling shall permit the connection of unthreaded, ungrooved, open-ended ductile iron pipe to ANSI/ASME B16.1, Class 125 flanges. The flange adapter coupling shall meet the test requirements of ANSI/ASME B16.1 for Class 125 flanges. The adapter shall be a ductile iron casting incorporating gripping wedges and gasket. The gasket shall provide a compression seal between the adapter, the pipe and the adjacent flange. Flange adapter couplings are to be used only in locations specifically shown on the Drawings and shall be installed in accordance with the manufacturer's recommendations. The flange adapter coupling shall be EBAA Iron Megaflange-Flange Adapter Series 2100.
- G. Grooved joint fittings shall be manufactured of ductile iron, conforming to ASTM A395 and A536 or cast iron, conforming to ASTM A48 with grooved ends in conformance with ANSI/AWWA C606. Grooved joint fittings shall conform to ANSI A21.10/AWWA C110.

2.03 JOINTS

A. General

1. Unless shown or specified otherwise, joints for buried service shall be push-on or restrained joint type for pipe and standard mechanical, push-on or restrained joints for fittings. Joints for exposed service shall be flanged for pipe and fittings, unless shown otherwise. Grooved joint fittings are allowable subject to the specified requirements in this section.
2. Provide the necessary bolts for connections. All bolts and nuts shall be threaded in accordance with ANSI B1.1, Coarse Thread Series, Class 2A external and 2B internal fit. All bolts and nuts shall be made in the U.S.A.
3. In all cases, gaskets shall be made of material that will not be damaged by the fluid being transported nor by the environment in which the pipe is installed.

B. Mechanical Joints

1. Joints shall conform to AWWA C111/ANSI A21.11.
2. Bolts and nuts shall be Tee Head bolts and nuts of high strength low-alloy steel in accordance with ASTM A 242 to the dimension shown in AWWA C111/ANSI A21.11.
3. Gaskets shall be in accordance with AWWA C111/ANSI A21.11 and shall be constructed of neoprene unless otherwise shown on the Drawings.
4. Mechanical joint glands shall be ductile iron.
5. Retainer Glands: Retainer glands shall be Megalug Series 1100, as manufactured by EBAA Iron.

C. Push-On Joints: Push-on joints and gaskets shall conform to AWWA C111/ANSI A21.11. Details of the joint design shall be in accordance with the manufacturer's standard practice such as ACIPCO "Fastite", McWane (Clow) "Bell-Tite", or U.S. Pipe "Tyton" joints.

D. Flanged Joints

1. Flanged joints shall conform to AWWA C115/ANSI A21.15. Flanges shall be ductile iron and shall be furnished by the pipe manufacturer.
2. Flanged joints shall be bolted with through stud or tap bolts of required size as directed. Bolt length and diameter shall conform to ANSI/AWWA C115 for Class 125 flanges shown in ANSI/ASME B16.1.
 - a. Bolts for exposed service shall be zinc plated, cold pressed, steel machine bolts conforming to ASTM A 307, Grade B. Nuts for exposed service shall be zinc plated, heavy hex conforming to ASTM A 563. Zinc plating shall conform to ASTM B 633, Type II.
 - b. Bolts for submerged service shall be stainless steel machine bolts conforming to ASTM A 193, Grade B8. Nuts shall be heavy hex, stainless steel conforming to ASTM A 194, Grade 8.

3. Gaskets shall be made of 1/8-inch thick, Neoprene. Gaskets may be ring type or full face type.
4. Flanged ductile iron pipe shall have flanges cast solidly or threaded to the pipe barrel. Pipe threads shall be of such length that with flanges screwed home, the end of the pipe shall project beyond the face line of the flange. Flange and pipe shall then be machined to give a flush finish to the pipe and the flange and surface shall be normal to the axis of the pipe. Ductile iron flanges shall be of such design that the flange neck completely covers the threaded portion of the pipe to protect same against corrosion. All pipe with threaded type flanges shall be assembled, faced, and drilled at the point of manufacture, unless otherwise approved by the Engineer.
5. Flange filler shall conform to AWWA C110/ANSI A21.10. Joint bolt length shall be increased by the thickness of the flange filler.
6. Where tap or stud bolts are required, flanges shall be drilled and tapped accordingly.

E. Restrained Joints

1. Restrained joints shall be ACIPCO "FLEX-RING" or U.S. Pipe "TR-FLEX" for piping larger than 36-inches.
2. For piping 36-inches and less, restraining gaskets shall be ACIPCO "Fast-Grip" or U.S. Pipe "Field-Lok Gasket".
3. Bolts, nuts, and joint accessories shall be in accordance with manufacturer's recommendation.
4. Gaskets shall be in accordance with manufacturer's recommendation.

F. Grooved Joints

1. Grooved joints may be used in lieu of flanged or threaded piping systems.
2. Grooved joint couplings shall consist of ductile iron housings, conforming to ASTM A395 and A536, complete with pressure responsive synthetic rubber gasket (grade to suit the intended service). This synthetic rubber is NSF 61 certified for contact with portable water. Victaulic Style 31 with Grade M Gasket.

2.04 WALL SLEEVES AND WALL PIPES

- A. Where piping passes through concrete structures, furnish and install wall sleeves unless wall pipes or other provisions are specifically shown on the Drawings.
- B. Wall Sleeves
 1. For pipe sizes smaller than 3-inches, wall sleeves shall be steel oversize sleeves furnished with a full circle, integral or continuously welded waterstop collar. The sleeve seal shall be the mechanically expanded, synthetic rubber type. Provide all associated bolts, seals and seal fittings, pressure clamps or plates necessary to achieve a watertight installation. Sleeves shall extend the full thickness of the concrete. All hardware shall be 316 stainless steel. Sleeves and seal shall be Link Seal.

2. For larger pipe sizes, wall sleeves shall be statically cast ductile iron mechanical joint wall sleeves. Unless specified or shown otherwise for a specific situation, wall sleeves shall be mechanical joint bell-plain end type with waterstop/thrust collar. Sleeves shall be constructed with studs and mechanical joint retainer gland on the air side of the concrete structure.

Provide retainer gland where shown on the Drawings. Where the concrete structure is exposed to dirt on one side and is wet on the other side, construct with studs and glands on the dirt side. Wall sleeves shall be equal to ACIPCO A-10771.

C. Wall Pipes

1. Wall pipes shall be either statically cast ductile iron with integral waterstop/thrust collar or centrifugally cast ductile iron with a continuously welded waterstop/thrust collar. The welded-on collar shall be attached to the pipe by the manufacturer. The collar shall be capable of withstanding a thrust force caused by a 250 psi dead end load from either direction on that size pipe. Wall pipes shall be furnished uncoated on the outside and cement lined on the inside.
2. Where shown on the Drawings, provide wall pipes (flange by restrained joint) which shall bolt to a Type C wall thimble provided by the sluice gate manufacturer. Class 125 flanges shall be provided.
3. Wall pipes shall be cast and/or fabricated and lined in one manufacturer's facility and delivered to the job site ready for use.
4. Wall pipe flanges shall be located 9-inches from wall to face of flange unless otherwise noted on the Drawings.

2.05 COATINGS

- A. The exterior of pipe and fittings for buried service shall be factory coated with an asphaltic coating conforming to AWWA C151/ANSI 21.51 for ductile iron pipe, AWWA C115/ANSI 21.15 for flanged pipe and AWWA C110/ANSI 21.10 for fittings. Pipe and fittings which shall be exposed or submerged shall be factory coated with a general purpose rust inhibitive primer compatible with the type of paint which will be field applied in accordance with the requirements of Section 09900 of these Specifications.

2.06 PIPE LININGS

- A. Cement Linings: Unless shown or specified otherwise, ductile iron pipe and fittings shall be cement lined in accordance with AWWA C104/ ANSI A21.4, standard thickness.
- B. Interior Lining: Ductile iron piping and fittings shall be epoxy lined where shown on the drawings.
- C. Epoxy Lining:
 1. Linings shall cover all exposed surfaces of pipe and fittings. The lining of the pipe barrel shall extend from spigot end through the socket to the edge of the gasket sealing area or recess for pipe using push-on gaskets, and to the edge of the gasket seat for mechanical joints. The lining shall also cover the exterior of the spigot end from the end of the pipe to beyond the gasket sealing area. The lining in fittings shall cover the interior surfaces including the socket areas as defined above. All linings

shall be hermetically sealed at the ends.

2. Lining Material: The lining material shall be Protecto 401 Ceramic Epoxy, a two component, modified epoxy formulated for corrosion control with the following minimum requirements:
 - a. A permeability rating of 0.0 perms when measured by ASTM E 96, Procedure A. Duration of the test shall be six weeks.
 - b. A direct impact resistance of 125 inch-pounds with no cracking when measured by ASTM D 2794.
 - c. The ability to build at least 50 mils dry in one coat.
 - d. The material shall be recoatable with itself for at least seven days with no additional surface preparation when exposed to direct summer sun and a temperature of 90 degrees F.
 - e. The material shall contain at least 20 percent by volume of ceramic quartz pigment.
 - f. A test and service history demonstrating the ability of the material to withstand the service expected.
 - g. Possess a minimum solids volume content of 88 percent, \pm one percent.
 - h. Possess a maximum drying time to allow recoating as follows: 50 degrees F - 72 hours; 75 degrees F - 18 hours; 90 degrees F - 8 hours. If recoating cannot be accomplished within seven days, a light brush blast shall be performed to improve intercoat adhesion.
3. Surface Preparation: The interior of the pipe exposed to liquids and gases shall be blasted and cleaned to remove all loose laitance, scale, or other loose material. No lining shall take place over grease, oil, etc., that would be detrimental to the adhesion of the compound to the substrate.
4. Application: The lining shall be applied using a centrifugal lance applicator by workers employed by Vulcan Painters, Inc. The workers shall be experienced and competent in the surface preparation, application and inspection of the lining to be applied. The compound shall not be applied when the substrate temperature is below 40 degrees F or in adverse atmospheric conditions which will cause detrimental blistering, pinholing or porosity of the film.
5. Lining of pipe barrel and fittings shall be 40 mils nominal thickness; minimum lining thickness shall be 30 mils. Lining thickness for exterior of spigot and interior of socket shall be 8 to 10 mils.
6. All pipe and fitting linings shall be tested for pinholes in accordance with ASTM G 62, Method B and shall be holiday free.
7. All pipe linings shall be checked for thickness using a magnetic film thickness gauge.
8. Each pipe joint and fitting shall be marked with the date of application of the lining system and with the numerical sequence of application of that date.”

2.07 EXPANSION JOINTS

- A. The Expansion Joint shall have a rubber inner tube, a body constructed of multiple piles of fabric impregnated with synthetic rubber, and a protective outer cover of synthetic rubber to provide resistance to deterioration from weather and ozone. Special covers shall be applied when indicated on the drawings to resist weather, ozone, and corrosive fumes. Steel wire shall be imbedded in the body for additional strength.
- B. The elastomer and fabric materials shall be determined by the temperature and chemical compatibility requirements, as indicated on the drawings.
 - 1. Class 1 - to 108°F: PGR, Neoprene, Buna-N, or Hypalon, with Nylon or Polyester reinforcement.
 - 2. Class II - to 250°F: Chlorobutyl, EPDM, or Teflon® -lined, with Polyester reinforcement.
 - 3. Class III - to 400°F: Solid Viton®, with Kevlar® reinforcement.
- C. Flanges shall be constructed integrally with the body to resist stresses. Flanges shall be full-pattern so that gaskets are not necessary. Flanges shall be drilled to ANSI B16.5 Class 150#. Flanges shall be accompanied with Galvanized 3/8" split steel retaining rings and enough control rods installed to achieve a working pressure of 200 psi.
- D. The expansion joint shall be available with a single arch or multiple arches, in open or filled arch (s) construction, and with wide arch(es) as specified on the drawings. Joint dimensions, movement, and spring rates for all variations shall follow Fluid Sealing Association guidelines.
- E. The elastomer construction of the joint acts to absorb vibration, preventing it from being transmitted to the piping, as well as compensation for lateral deflection. The integral arch allows for axial compression and elongation of the joint, to compensate for expansion and contraction of the piping.
- F. All expansion joints shall be Redflex™ Type J-1 as manufactured by the Red Valve Company, Inc. of Carnegie, PA 15105 or approved equal.

PART 3 EXECUTION

3.01 CUTTING

- A. When new or existing pipe is required to be cut, the pipe shall be cut in such a manner as to leave a smooth end normal to the axis of the pipe.
- B. All cutting of ductile iron pipe shall be performed with a cutting saw. All burrs shall be removed from the inside and outside edges of all cut pipe. All damaged linings and coatings shall be repaired.
- C. Lining Repair: Repair linings and recoat spigot ends of cut pipe with a product equal to Protecto 401 in accordance with the manufacturer's recommendations and as specified below:

1. Remove all burrs and areas of loose lining materials by sanding or scraping to bare metal.
2. Remove oil and lubricants used during field cutting.
3. Lining shall be stripped back a minimum of 1-inch from the spigot end into well adhered lined areas.
4. Roughen 1 to 2-inches of good lining with a rough grade (40 grit) emery paper, rasp or small chisel, to allow an overlap between new and existing lining.
5. Apply lining repair material in the number of coats required to match the thickness requirements as specified in Part 2 of this Section and in accordance with the manufacturer's recommendations.

3.02 JOINT ASSEMBLY

- A. General: Ductile iron pipe shall be assembled in accordance with ANSI/AWWA C600.
- B. Push-On Joints: The inside of the bell and the outside of the pipe from the plain end to the guide stripe shall be wiped clean immediately before assembling the pipe joint. Then the rubber gasket shall be inserted into a groove or shaped recess in the bell. Both the bell and spigot ends to be joined shall be wiped again to ensure they are thoroughly clean. A liberal coating of special lubricant furnished by the pipe manufacturer shall be applied to the outside of the pipe. The plain end shall be centered in the bell and the spigot pushed home.
- C. Mechanical Joints
 1. The surfaces with which the rubber gasket comes in contact shall be brushed thoroughly with a wire brush just prior to assembly to remove all loose rust or foreign material which may be present and to provide clean surfaces which shall be brushed with a liberal amount of soapy water or other approved lubricant just prior to slipping the gasket over the spigot end and into the bell. Lubricant shall be brushed over the gasket prior to installation to remove loose dirt and lubricate the gasket as it is forced into its retaining space.
 2. Joint bolts shall be tightened by the use of wrenches and to a tension recommended by the pipe manufacturer. When tightening bolts, the gland shall be brought up toward the pipe bell. If effective sealing is not attained at the maximum torque indicated above, the joint shall be disassembled and reassembled after thorough cleaning. Overstressing of bolts to compensate for poor installation shall not be permitted.
 3. After installation, bolts and nuts in buried piping shall be given two heavy coats of a bituminous paint. Bolts and nuts for exposed or submerged service shall be coated in accordance with the requirements of Section 09 90 00 of these Specifications.
- D. Flanged Joints
 1. All flanges shall be true and perpendicular to the axis of the pipe. Flanges shall be cleaned of all burrs, deformations, or other imperfections before joining. Flanged joints shall be installed so as to ensure uniform gasket compression. All bolting shall be pulled up to the specified torque by crossover sequence. Where screwed flanges are used, the finished pipe edge shall not extend beyond the face of the flange, and the flange neck shall completely cover the threaded portion of the pipe.

2. Connections to equipment shall be made in such a way that no torque is placed on the equipment flanges. Connecting flanges must be in proper position and alignment and no external force may be used to bring them together properly.
3. After installation, bolts and nuts for exposed or submerged service shall be coated in accordance with the requirements of Section 09 90 00 of these Specifications.
4. Flanged filler shall be used only where shown on the Drawings or approved by the Engineer to make up minor differences in pipe length, less than 3-inches. Joint bolts shall be increased in length by the thickness of the flange filler.

E. Grooved Joints

All grooved couplings, fittings and valves shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be molded and produced by the grooved coupling manufacturer. Grooved ends shall be clean and free from indentations and projections in the area from pipe end to groove. Grooved coupling manufacturer's factory trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools, application of groove, and installation of grooved piping products. Factory trained representative shall periodically inspect the product installation. Contractor shall remove and replace any improperly installed products.

- F. Joints of Dissimilar Metals: When a flanged joint consists of a ductile iron flange mated to a steel or alloy flange, the steel flanges shall be flat faced and furnished with full-faced gaskets, insulating bushings.

3.03 DRILLING AND TAPPING

- A. Wherever required ductile iron pipe and fittings shall be drilled and tapped to receive drainage or any other piping. All holes shall be drilled accurately at right angles to the axis of any pipe or fitting. Where plugs are drilled, holes shall be at right angles to the face of the plug.
- B. Unless shown otherwise, small diameter pipes, less than 2-inches, shall be connected to ductile iron pipe using one of the following methods:
1. Direct tap.
 2. Direct tap with service saddle.
 3. Direct tap boss.
 4. Tapped plug or flange on tapping saddle.
- C. In no case shall the effective number of threads be less than 4.

3.04 CONSTRUCTING BENEATH AND BEYOND STRUCTURES

- A. Construct beyond buildings and structures in accordance with Section 31 23 16.13 of these Specifications.
- B. All ductile iron pipe installed under buildings or basins shall be encased and backfilled in accordance with Section 31 23 23.13 of these Specifications.

- C. All ductile iron pipes entering buildings or basins shall be adequately supported between the structure and undisturbed earth to prevent damage resulting from settlement of backfill around the structure.

3.05 CONSTRUCTING WITHIN STRUCTURES

- A. Proper and suitable tools and appliances for safe and convenient handling and laying of pipe and fittings shall be used. Care shall be taken to prevent the pipe coating from being damaged, particularly cement linings on the inside of the pipes and fittings. Any damage shall be remedied as directed by the Engineer.
- B. All pipe and fittings shall be carefully examined by the Contractor for defects just before installing and no pipe or fitting shall be installed if it is defective. If any defective pipe or fitting is discovered after having been installed, it shall be removed and replaced in a satisfactory manner with a sound pipe or fitting by the Contractor at Contractor's own expense.
- C. All pipes and fittings shall be thoroughly cleaned before they are installed and shall be kept clean until they are used in the completed work. Open ends of pipe shall be kept plugged with a bulkhead during construction.
- D. All elbows, tees, brackets, crosses, and reducers in pressure piping systems shall be adequately restrained against thrust.
- E. Wall pipe and wall sleeves shall be accurately located and securely fastened in place before concrete is poured. All wall pipe and sleeves shall have wall collars properly located to be in the center of the wall where the respective pipes are to be installed. Pipe passing through the sleeve shall extend no more than three feet beyond the structure without a piping joint.
- F. Wall pipe and wall sleeves shall be constructed when the wall or slab is constructed. Blocking out or breaking of the wall for later installation shall not be permitted.
- G. Cutting or weakening of structural members to facilitate pipe installation shall not be permitted. All piping shall be installed in place without springing or forcing.
- H. Exposed ductile iron piping shall be supported as shown on the Drawings or as specified in Section 22 05 29 of these Specifications.

3.06 FIELD PAINTING

Field painting of exposed and submerged pipe shall be in accordance with the requirements of Section 09 90 00 of these Specifications.

3.07 INSPECTION AND TESTING

All testing shall be in accordance with the requirements of Section 01 45 29 of these Specifications.

3.08 DISINFECTION

Following installation and testing, potable water lines shall be disinfected in accordance with the requirements of Section 33 11 00 of these Specifications.

3.09 CLEANING

In accordance with Section 01 74 19 of these Specifications.

END OF SECTION

**FACTORY-BUILT 6X6 ABOVE GROUND PUMP STATION
WITH DUPLEX SELF-PRIMING PUMPS**

PART - GENERAL

- 1.01 Work under this section includes, but is not limited to furnishing and installing a factory built duplex pump station as indicated on the project drawings, herein specified, as necessary for proper and complete performance.
- 1.02 Publications listed below form part of this specification to extent referenced in the text by basic designation only. Consult latest edition of publication unless otherwise noted.

- A. American National Std. Institute (ANSI) / American Water Works Assoc. (AWWA)
 - 1. ANSI B16.1 Cast iron pipe flanges and flanged fittings.
 - 2. ANSI/AWWA C115/A21.51 Cast/ductile iron pipe with threaded flanges.
 - 3. ANSI 253.1 Safety Color Code for Marking Physical Hazards.
 - 4. ANSI B40.1 Gages, Pressure and Vacuum.
 - 5. AWWA C508 Single Swing Check Valves.

- B. American Society for Testing and Materials (ASTM)
 - 1. ASTM A48 Gray Iron Castings.
 - 2. ASTM A126 Valves, Flanges, and Pipe Fittings.
 - 3. ASTM A307 Carbon Steel Bolts and Studs.
 - 4. ASTM A36 Structural Steel.

- C. Institute of Electrical and Electronics Engineers (IEEE)
 - 1. IEEE Std 100 Standard Dictionary of Electrical Terms.
 - 2. IEEE Std 112 Test Procedure for Polyphase Induction Motors.
 - 3. IEEE Std 242 Protection of Industrial and Control Power Systems.

- D. National Electric Code (NEC) / National Electrical Manufacturers' Assoc. (NEMA)
 - 1. NEC National Electrical Code.
 - 2. NEMA Std MG1 Motors and Generators.

- E. Miscellaneous References
 - 1. Ten-State Standards Recommended Standards for Sewage Works.
 - 2. Hydraulic Institute Std for Centrifugal, Rotary and Reciprocating Pumps.
 - 3. ISO 9001 International Organization for Standardization.
 - 4. ISO 14001 International Organization for Standardization.

1.03 SYSTEM DESCRIPTION

- A. Design requirements consist of factory built pump station design, including materials of construction, pump features, valves and piping, and motor controls shall be in accordance with requirements listed under PART 2 - PRODUCTS of this section.
 - 1. Contractor shall furnish and install one factory built above ground, automatic pump station. The station shall be complete with all equipment specified herein, factory assembled in a fiberglass reinforced polyester resin enclosure.
 - 2. In addition to the station enclosure, principle items of equipment shall include two horizontal, self priming, centrifugal sewage pumps, V-belt drives, motors, internal piping, valves, motor control panel, automatic liquid level control system, and internal wiring.

- B. Performance Criteria
 - 1. Pumps must be designed to handle raw, unscreened, domestic sanitary sewage. Pumps shall have ___" suction connection, and ___" discharge connection. Each pump shall be selected to perform under following operating conditions:
 - a. Capacity (GPM) _____
 - b. Total Dynamic Head(FT) _____
 - c. Total Dynamic Suction Lift(FT) _____
 - d. Maximum Repriming Lift(FT) _____

- e. Maximum Static Suction Lift(FT) _____
- f. Total Discharge Static Head(FT) _____
- g. Minimum Submergence Depth (FT) _____

C. Utility Power Requirements

1. Site power furnished to pump station shall be 3 phase, 60 hertz, 277/480 volts, 4 wire, maintained within industry standards. The available fault current provided at the pump station control panel is 22 kA rms symmetrical. Voltage tolerance shall be plus or minus 10 percent. Phase-to-phase unbalance shall not exceed 1% average voltage as set forth in NEMA Standard MG-1. Control voltage shall not exceed 132 volts.

1.04 SUBMITTALS

A. Product Data

1. Prior to fabrication, pump station manufacturer shall submit _____ copies of submittal data for review and approval.
2. Submittal shall include shop drawings, electrical ladder logic drawings, and support data as follows: Catalog cuts sheets reflecting characteristics for major items of equipment, materials of construction, major dimensions, motor and v-belt drive data, pump characteristic curves showing the design duty point capacity (GPM), head (FT), net positive suction head required (NPSHr), and hydraulic brake horsepower (BHP). Electrical components used in the motor branch and liquid level control shall be fully described.

B. Shop Drawings

1. Shop drawings shall provide layout of mechanical equipment and anchor bolt locations for station. Pipe penetrations and station access clearances shall be dimensioned relative to the station centerline. The electrical ladder logic drawings shall illustrate motor branch and liquid level control circuits to extent necessary to validate function and integration of circuits to form a complete working system.

C. Operations and Maintenance Manuals

1. Operation shall be in accordance with written instructions provided by the pump 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. Documentation shall be specific to the pump station supplied 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. Electrical schematic diagram of the pump station circuits shall be in accordance with NFPA 70. 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 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 pump 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.

1.05 QUALITY ASSURANCE

A. Manufacturer's Qualifications

1. The pumps and pump station manufacturer must be ISO 9001:2008 revision certified, with scope of registration including design control and service after sales activities.
2. The pumps and pump station manufacturer must be registered to the ISO 14001 Environmental Management System standard and as such is committed to minimizing the impact of its activities on the environment and promoting environmental sustainability by the use of best management practices, technological advances, promoting environmental awareness and continual improvement.
3. Upon request from the engineer, the pump 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.
4. Manufacturer must show proof of original product design and testing. Products violating intellectual property regulations shall not be allowed, as they may violate international law and expose the user or engineer to unintended liabilities. "Reverse-engineered" products fabricated to substantially duplicate the design of original product shall not be allowed, as they may contain substantial differences in tolerances and material applications addressed in the original design, which may contribute to product failure.
5. The term "pump manufacturer" or "pump station manufacturer" shall be defined as the entity which designs, machines, assembles, hydraulically tests and warrants the final product. Any entity that does not meet this definition will not be considered a "pump manufacturer" or "pump station manufacturer" and is not an acceptable supplier. For quality control reasons and future pump and parts availability, all major castings of the pump shall be sourced and machined in North America.

B. Pump Performance Certifications

1. Solids Handling Capability
 - a. All internal passages, impeller vanes, and recirculation ports shall pass a ___" spherical solid. Smaller internal passages that create a maintenance nuisance or interfere with priming and pump performance shall not be permitted. Upon request from the engineer, manufacturer's certified drawings showing size and location of the recirculation port(s) shall be submitted for approval.
2. Reprime Performance
 - a. Consideration shall be given to the sanitary sewage service anticipated, in which debris is expected to lodge between the suction check valve and its seat, resulting in the loss of the pump suction leg, and siphoning of liquid from the pump casing to the approximate center line of the impeller. Such occurrence shall be considered normal, and the pump must be capable of automatic, unattended operation with an air release line installed.
 - b. During unattended operation, the pump shall retain adequate liquid in the casing to insure automatic repriming while operating at its rated speed in a completely open system. The need for a suction check valve or external priming device shall not be required.
 - c. Pump must reprime ___ vertical feet at the specified speed and impeller diameter. Reprime lift is defined as the static height of the pump suction above the liquid, while operating with only one-half of the liquid remaining in the pump casing. The pump must reprime and deliver full capacity within five minutes after the pump is energized in the reprime condition. Reprime performance must be confirmed with the following test set-up:

- 1) A check valve to be installed down stream from the pump discharge flange. The check valve size shall be equal (or greater than) the pump discharge diameter.
 - 2) A length of air release pipe shall be installed between pump and the discharge check valve. This line shall be open to atmosphere at all times duplicating the air displacement rate anticipated at a typical pump station fitted with an air release valve.
 - 3) The pump suction check valve shall be removed. No restrictions in the pump or suction piping will prevent the siphon drop of the suction leg. Suction pipe configuration for reprime test shall incorporate a 2 feet minimum horizontal run, a 90 degree elbow and vertical run at the specified lift. Pipe size shall be equal to the pump suction diameter.
 - 4) Impeller clearances shall be set as recommended in the pump service manual.
 - 5) Repeatability of performance shall be demonstrated by testing five consecutive reprime cycles. Full pump capacity (flow) shall be achieved within five minutes during each cycle.
 - 6) Liquid to be used for reprime test shall be water.
3. Upon request from the engineer, certified reprime performance test results, prepared by the manufacturer, and certified by a registered professional engineer, shall be prepared and forwarded to the customer.

**(Optional Certified Pump Performance Test)*

C. Certified Pump Performance Test

1. Tests shall be conducted in accordance with Hydraulic Institute Standards 14.6.3.4 Acceptance Grade 2B at the specified head, capacity, rated speed and horsepower. The performance tests will validate the correct performance of the equipment at the design head, capacity and speed.
2. For pumps utilizing up to (13 HP) motors; but larger than (1.3 HP), tests shall be conducted in accordance with Hydraulic Institute Standards 14.6.3.4.1, as the specified head, capacity, rated speed and horsepower.

D. Factory System Test

1. All internal components including the pumps, motors, valves, piping and controls will be tested as a complete working system at the manufacturer's facility. Tests shall be conducted in accordance with Hydraulic Institute Standards at the specified head, capacity, rated speed and horsepower. Factory operational test shall simulate actual performance anticipated for the complete station.
2. Upon request from the engineer, the operational test may be witnessed by the engineer, and/or representatives of their choice, at the manufacturer's facility.

E. Manufacturer's Start-up Services

1. 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 as described in Part 3 of this section.

1.06 MANUFACTURER'S WARRANTY

- A. The pump 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. In addition to defects in material and workmanship, fiberglass reinforced polyester station enclosures are warranted for sixty (60) months to be resistant to rust, corrosion, corrosive soils, effects of airborne contamination or physical failures occurring in normal service for the period of the pump station warranty.
 2. All other equipment, apparatus, and parts furnished shall be warranted for sixty (60) months, excepting only those items that are normally consumed in service, such as light bulbs, oils, grease, packing,

gaskets, O-rings, etc. The pump station manufacturer shall be solely responsible for warranty of the station and all components.

- B. 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.
- C. It is not intended that the station manufacturer assume liability for consequential damages or contingent liabilities arising from failure of any vendor supplied product or part which fails to properly operate, however caused. Consequential damages resulting from defects in design, or delays in delivery are also beyond the manufacturer's scope of liability.
- D. Equipment supplied by others and incorporated into a pump station or enclosure is not covered by this limited warranty. Any warranty applicable to equipment selected or supplied by others will be limited solely to the warranty, if any, provided by the manufacturer of the equipment.
- E. This limited warranty shall be valid only when installation is made and use and maintenance is performed in accordance with manufacturer recommendations. A start-up report completed by an authorized manufacturer's representative must be received by manufacturer within thirty (30) days of the initial date the unit is placed into service. The warranty shall become effective on the date of acceptance by the purchaser or the purchaser's authorized agent, or sixty (60) days after installation, or ninety (90) days after shipment from the factory, whichever occurs first.

PART 2 – PRODUCT

2.01 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). 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.

2.02 MANUFACTURER

- A. The pump station system integrator must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.
- B. The specifications and project drawings depict equipment and materials manufactured by The Gorman-Rupp Company which are deemed most suitable for the service anticipated. It is not intended, however, to eliminate other products of equal quality and performance. The contractor shall prepare their bid based on the specified equipment for purposes of determining low bid. Award of a contract shall constitute an obligation to furnish the specified equipment and materials.
- C. After execution of the contract, the contractor may offer substitutions to the specified equipment for consideration. The equipment proposed for substitution must be superior in construction and performance to that specified in the contract, and the higher quality must be demonstrated by a list of current users of the proposed equipment in similar installations.
- D. In event the contractor obtains engineer's approval for equipment substitution, the contractor shall, at their own expense, make all resulting changes to the enclosures, buildings, piping or electrical systems as required to accommodate the proposed equipment. Revised detail drawings illustrating the substituted equipment shall be submitted to the engineer prior to acceptance.
- E. It will be assumed that if the cost to the contractor is less for the proposed substitution, then the contract price shall be reduced by an amount equal to the savings.

2.03 STATION ENCLOSURE

- A. The station enclosure shall contain and protect all pumps, interior piping, valves and associated controls. Enclosure shall incorporate the following design and service features:
 - 1. Access panels must be supplied on all sides. Location and size shall permit access for routine maintenance functions such as pump and motor inspection, drive belt adjustment, and pump clean-out. Non-hinged panels shall be secured with stainless steel tamper-proof hardware.

2. A continuous hinge and latch shall be installed on at least two access panels. The hinged panels shall allow easy access to the electrical controls for frequent adjustments and inspections. A two-point mechanical latch assembly shall secure the panel at top and bottom. Latch handle locks shall be match keyed, requiring only one key to open all access panels.
 3. A vent in one access panel shall allow free air flow for enclosure ventilation.
 4. The complete station enclosure, less base, must be completely removable after disengaging reusable hardware. After disassembly, no portion of the enclosure (except electrical service entrance) shall project above the base surface to interfere with maintenance or endanger personnel.
 5. Disassembly and removal of the enclosure shall require no more than two people working without assistance of lifting equipment.
- B. Station enclosure shall be manufactured of molded reinforced orthophthalic polyester resins with a minimum of 30% fiberglass, and a maximum of 70% resin. Resin fillers or extenders shall not be used.
1. Chopped glass fibers of 1 1/4 inch average length shall be sprayed and rolled. Major design consideration shall be given to structural stability, corrosion resistance, and watertight integrity. The polyester laminates shall provide a balance of mechanical, chemical, and electrical properties to insure long life. They must be impervious to micro-organisms, mildew, mold, fungus, corrosive liquids, and gases which are expected to be present in the environment surrounding the wet well.
 2. All interior surfaces of the housing shall be coated with a polyester resin-rich finish providing maintenance-free service, abrasion resistance, and protection from sewage, greases, oils, gasoline, and other common chemicals.
 3. Outside surfaces of the enclosure shall be coated with gel-coat pigmented resin to insure long maintenance-free life and UV protection. Color used shall de-emphasize the presence of dirt, grease, etc.
- C. Station base shall be constructed of pre-cast, reinforced concrete encapsulated in a fiberglass mold. The design shall resist deformation of the structure during shipping, lifting, or handling. Base shall incorporate drainage provisions, and an opening sized to permit installation of piping and service connections to the wet well. After installation, the opening shall serve as a grout dam to be utilized by the contractor. The base shall incorporate anchor bolt recesses for securing the complete station to a concrete pad (supplied by the contractor) in accordance with the project plans.
- D. A blower mounted in the station roof shall be sized to exchange station air volume at least once every two minutes. Blower motor shall energize automatically at approximately 70 degrees F, and turn off at 55 degrees F. The blower motor control circuit shall incorporate a thermal-magnetic circuit breaker providing overcurrent and overload protection. Exhaust and inlet locations shall prevent the entrance of rain, snow, or debris.

(Optional Pump and Station Accessory for **6x6T TALL ENCLOSURE)*

E. Tall Enclosure with Split Doors

1. The station shall be equipped with a 91 inch tall fiberglass enclosure. The control panel side and suction side of the fiberglass enclosure shall have split doors with the upper section of the doors raised vertically and the lower section of the doors opening horizontally outward. The upward portion of the split doors shall have additional equipment installed to prevent premature closing of the door. The pump station shall be furnished with 1" thick spray foam insulation, which shall be applied to the roof, doors, and corner panels.

(Optional Pump and Station Accessory for **STATION HEATER)*

F. Station Heater

1. Pump station shall be provided with a 1300/1500 watt, 115 volt electric heater with cord and grounding plug. Ungrounded heaters shall not be acceptable.

(Optional Pump and Station Accessory for **STATION INSULATION PACKAGE)*

G. Insulation Package

1. The pump station shall be furnished with 1" thick spray foam insulation, which shall be applied to the roof, doors, and corner panels.

(Optional Accessory for **DOOR OPEN NOTIFICATION)*

H. Door Open Notification

1. The station enclosure shall include limit switches with defeater switch alarm circuit and time delay, mounted and wired in the station enclosure to indicate that there has been a door left open or unauthorized entry to the station. There shall be an adjustable time period for the operator to disable alarm with an unmarked pushbutton located inside the station. The notification shall be activated when a station door or access panel is opened. Includes dry contacts pre-wired to a terminal strip for remote monitoring.

(Optional Pump and Station Accessory for **STATION LIGHT)*

I. Hand Lamp

1. Pump station shall be provided with a 100 watt, 115 volt AC vapor-tight hand lamp with 25 feet of cord and grounding plug. Hand lamp shall be constructed of corrosion resistant materials, and shall be equipped with a guard and a clear globe. Ungrounded hand lamps may be supplied if provided with an effective means of double insulation.

(Specifier note: Insert this section for **Super T Series Pumps)*

2.04 PUMP DESIGN

- A. Pumps shall be horizontal, self-priming centrifugal type, designed specifically for handling raw, unscreened, domestic sanitary sewage. Pump solids handling capability and performance criteria shall be in accordance with requirements listed under PART 1 - GENERAL of this section.
- B. The pump manufacturer must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.
- C. Materials and Construction Features
 1. Pump casing: Casing shall be cast iron Class 30 with integral volute scroll. Casing shall incorporate following features:
 - a. Mounting feet sized to prevent tipping or binding when pump is completely disassembled for maintenance.
 - b. Fill port coverplate, 3 1/2" diameter, shall be opened after loosening a hand nut/clamp bar assembly. In consideration for safety, hand nut threads must provide slow release of pressure, and the clamp bar shall be retained by detente lugs. A Teflon gasket shall prevent adhesion of the fill port cover to the casing.
 - c. Casing drain plug shall be at least 1 1/4" NPT to insure complete and rapid draining.
 - d. Liquid volume and recirculation port design shall be consistent with performance criteria listed under PART 1 - GENERAL of this section.
 2. Coverplate: Coverplate shall be cast iron Class 30. Design must incorporate following maintenance features:
 - a. Retained by hand nuts for complete access to pump interior. Coverplate removal must provide ample clearance for removal of stoppages, and allow service to the impeller, seal, wearplate or check valve without removing suction or discharge piping.

- b. A replaceable wearplate secured to the coverplate by weld studs and nuts shall be AISI 1015 HRS.
 - c. In consideration for safety, a pressure relief valve shall be supplied in the coverplate. Relief valve shall open at 75-200 PSI.
 - d. Two O-rings of Buna-N material shall seal coverplate to pump casing.
 - e. Pusher bolt capability to assist in removal of coverplate. Pusher bolt threaded holes shall be sized to accept same retaining capscrews as used in rotating assembly.
 - f. Easy-grip handle shall be mounted to face of coverplate.
3. Rotating Assembly: A rotating assembly, which includes impeller, shaft, mechanical shaft seal, lip seals, bearings, sealplate and bearing housing, must be removable as a single unit without disturbing the pump casing or piping. Design shall incorporate following features:
- a. Sealplate and bearing housing shall be cast iron Class 30. Separate oil filled cavities, vented to atmosphere, shall be provided for shaft seal and bearings. Cavities must be cooled by the liquid pumped. Three lip seals will prevent leakage of oil.
 - 1) The bearing cavity shall have an oil level sight gauge and fill plug check valve. The clear sight gauge shall provide easy monitoring of the bearing cavity oil level and condition of oil without removal of the fill plug check valve. The check valve shall vent the cavity but prevent introduction of moist air to the bearings.
 - 2) The seal cavity shall have an oil level sight gauge and fill/vent plug. The clear sight gauge shall provide easy monitoring of the seal cavity oil level and condition of oil without removal of the fill/vent plug.
 - 3) Double lip seal shall provide an atmospheric path providing positive protection of bearings, with capability for external drainage monitoring.
 - b. Impeller shall be ductile iron, two-vane, semi-open, non-clog, with integral pump out vanes on the back shroud. Impeller shall thread onto the pump shaft and be secured with a lockscrew and conical washer.
 - c. Shaft shall be AISI 4140 alloy steel unless otherwise specified by the engineer, in which case AISI 17-4 pH stainless steel shall be supplied.
 - d. Bearings shall be anti-friction ball type of proper size and design to withstand all radial and thrust loads expected during normal operation. Bearings shall be oil lubricated from a dedicated reservoir. Pump designs which use the same oil to lubricate the bearings and shaft seal shall not be acceptable.
 - e. Shaft seal shall be oil lubricated mechanical type. The stationary and rotating seal faces shall be tungsten titanium carbide alloy. Each mating surface shall be lapped to within three light bands flatness (35 millionths of an inch), as measured by an optical flat under monochromatic light. The stationary seal seat shall be double floating by virtue of a dual O-ring design; an external O-ring secures the stationary seat to the sealplate, and an internal O-ring holds the faces in alignment during periods of mechanical or hydraulic shock (loads which cause shaft deflection, vibration, and axial/radial movement). Elastomers shall be viton. Cage and spring to be stainless steel. Seal shall be oil lubricated from a dedicated reservoir. The same oil shall not lubricate both shaft seal and shaft bearings. Seal shall be warranted in accordance with requirements listed under PART 1 - GENERAL of this section.
 - f. Pusher bolt capability to assist in removal of rotating assembly. Pusher bolt threaded holes shall be sized to accept same capscrews as used for retaining rotating assembly.
4. Adjustment of the impeller face clearance (distance between impeller and wearplate) shall be accomplished by external means.
- a. Clearances shall be maintained by a four point external shimless coverplate adjustment system, utilizing a four collar and four adjusting screw design allowing for incremental adjustment of clearances by hand as required. Each of the four points shall be lockable to prevent inadvertent clearance increases or decreases due to equipment vibration or accidental operator contact. The

four point system also allows for equal clearance gaps at all points between the impeller and wear plate. Requirement of realignment of belts, couplings, etc., shall not be acceptable. Coverplate shall be capable of being removed without disturbing clearance settings. Clearance adjustment systems that utilize less than four points will not be considered.

- b. There shall be provisions for additional clearance adjustment in the event that adjustment tolerances have been depleted from the coverplate side of the pump. The removal of stainless steel shims from the rotating assembly side of the pump shall allow for further adjustment as described above
 - c. Clearance adjustment which requires movement of the shaft only, thereby adversely affecting seal working length or impeller back clearance, shall not be acceptable.
5. Suction check valve shall be molded Neoprene with integral steel and nylon reinforcement. A blow-out center shall protect pump casing from hydraulic shock or excessive pressure. Removal or installation of the check valve must be accomplished through the coverplate opening, without disturbing the suction piping. Sole function of check valve shall be to save energy by eliminating need to reprime after each pumping cycle. Pumps requiring a suction check valve to assist reprime will not be acceptable.
 6. Spool flanges shall be one-piece cast iron, class 30 fitted to suction and/or discharge ports. Each spool shall have one 1-1/4" NPT and one 1/4" NPT tapped hole with pipe plugs for mounting gauges or other equipment.

D. Serviceability

1. The pump manufacturer shall demonstrate to the engineer's satisfaction that consideration has been given to reducing maintenance costs.
2. No special tools shall be required for replacement of any components within the pump.

(Optional Pump and Station Accessory for **PUMP DRAIN KIT)*

E. Drain Kit

1. Pumps to be supplied with a drain kit for ease of maintenance. The kit shall contain 10' length of reinforced plastic hose with a female quick connect fitting at one end, and factory installed drain fittings in each pump. Fittings include a stainless steel pipe nipple, stainless steel bushing, stainless steel ball valve and aluminum male quick connect fitting.

(Optional Pump and Station Accessory for **SPARE PARTS KIT)*

F. Spare Parts Kit:

1. The following minimum spare parts shall be furnished with the pump station:
 - a. One pump mechanical seal
 - b. Required cover plate O-Ring(s)
 - c. One rotating assembly O-Ring(s)
 - d. One set of impeller clearance adjustment spacers

(Optional Pump and Station Accessory for **VOLUTE CASING HEATERS)*

G. Volute Casing Heaters

1. Pump shall be provided with a thermostat mounted to the exterior of the volute casing, and a ___ watt 115 volt electric heater inserted into the interior of the volute by means of a dedicated port. The heater shall be energized at 43+/-3 degrees F to provide heat to the casing and eliminate the possibility of freezing. Heater probes that must be installed through a pump drain port shall not be acceptable.

2.05 VALVES AND PIPING

- A. Check Valve: Each pump shall be equipped with a full flow type check valve capable of passing a 3" spherical solid. Valve shall be constructed with flanged ends and fitted with an external lever and torsional

spring. Valve seat shall be constructed of stainless steel, secured to the body to ensure concentricity, sealed by an O-ring, and shall be replaceable. The valve body shall be cast iron incorporating a clean-out port large enough to allow removal and/or replacement of the valve clapper without removing valve or piping from the line. Valve clapper shall have a molded neoprene seating surface incorporating low pressure sealing rings. Valve hinge pin and internal hinge arm shall be stainless steel supported on each end in brass bushings. Shaft nut shall have double O-rings which shall be easily replaceable without requiring access to interior of valve body. All internal hardware shall be stainless steel. Valve shall be rated at 175 PSI water working pressure, 350 PSI hydrostatic test pressure. Valves other than full flow type or valves mounted in such a manner that prevents the passage of a 3" spherical solid shall not be acceptable.

- B. Plug Valve: A 3-way plug valve must allow either or both pumps to be isolated from the force main. The plug valve shall be non-lubricated, tapered type. Valve body shall be cast iron with flanged end connections drilled to 125 pound standard. The drip-tight shutoff plug shall be mounted in stainless steel bearings, and shall have a resilient facing bonded to the sealing surface. Valve shall be operated with a single lever actuator providing lift, turn, and reseal action. The lever shall have a locking device to hold the plug in the desired position.

(Optional Pump and Station Accessory for **AIR RELEASE VALVE #GRP33-07 AIR RELEASE VALVES)*

C. Automatic air release valves:

1. An automatic air release valve shall be furnished for each pump designed to permit the escape of air to the atmosphere during initial priming or unattended repriming cycles. Upon completion of the priming cycle or repriming cycle, the valve shall close to prevent recirculation. Valves shall provide visual indication of valve closure, and shall operate solely on discharge pressure. Valves which require connection to the suction line shall not be acceptable.
2. All valve parts exposed to sewage shall be constructed of cast iron, stainless steel, or similar corrosion resistant materials. Diaphragms, if used, shall be of fabric-reinforced neoprene or similar inert material.
3. A cleanout port, three inches in diameter, shall be provided for ease of inspection, cleanout, and service.
4. Valves shall be field adjustable for varying discharge heads.
5. Connection of the air release valves to the station piping shall include stainless steel fittings.

(Optional Pump and Station Accessory for **GAUGE KIT)*

D. Gauge Kit

1. A gauge kit shall be supplied for each pump. Suction pressure must be monitored by a glycerin-filled compound gauge, and discharge pressure by a glycerin-filled pressure gauge. Gauges to be at least 4 inches in diameter, graduated in feet water column. Rated accuracy shall be 1% of full scale reading. Compound gauge shall be graduated -34 to +34 feet water column minimum. Pressure gauge to be graduated 0 to 140 feet water column minimum.
2. Gauges to be factory mounted on a resilient panel with frame assembly secured to pumps or piping. Gauge installations shall be complete with all hoses and stainless steel fittings, including a shutoff valve for each gauge line at the point of connection to suction and discharge pipes.

(Optional Controls and Accessory for **STATION ENCLOSURE LOW TEMPERATURE ALARM)*

E. Station Enclosure Low Temperature Alarm

1. Pump station shall be supplied with a thermostat which shall monitor interior station temperature. The control shall incorporate an unpowered dry contact wired to terminal blocks for field connection to a remote alarm device. The contact will close in the event that the temperature within the enclosure falls below approximately 35 degrees F.

F. Piping

1. Flanged header pipe shall be centrifugally cast, ductile iron, complying with ANSI/AWWA A21.51/C115 and class 53 thickness.

2. Flanges shall be cast iron class 125 and Comply with ANSI B16.1.
 3. Pipe and flanges shall be threaded and suitable thread sealant applied before assembling flange to pipe.
 4. Bolt holes shall be in angular alignment within 1/2 degree between flanges. Flanges shall be faced with a gasket finish having concentric grooves a minimum of 0.01 inch deep by approximately 0.03 inch wide, with a minimum of three grooves on any given surface spaced a maximum of 1/4 inch apart.
- G. Supports and Thrust Blocks: Contractor must insure all pipes connected to the pump station are supported to prevent piping loads from being transmitted to pumps or station piping. Pump station discharge force main piping shall be anchored with thrust blocks where shown on the contract drawings.

(Optional Accessory for 3" or 4" **PORTABLE PUMP DISCHARGE CONNECTION)*

H. Portable Pump Discharge Connection

1. The station header pipe shall incorporate a 2-way plug valve to permit emergency access to the pump station force main after isolation of the pumps. Valve body shall be cast iron with flanged end connections drilled to 125 pound standard. The plug valve shall be non-lubricated type, furnished with a drip-tight shutoff plug mounted in stainless steel or Teflon over phenolic bearings, and shall have a resilient facing bonded to the sealing surface.
2. The bypass connection shall be accessible behind the hinged access panel on the wet well side of the station enclosure and shall terminate with a male OPW type quick connect fitting.

2.06 DRIVE UNIT

A. Motors (Note: Maximum motor frame size is 326T open drip-proof.)

1. Pump motors shall be 10 HP, horizontal ODP, 1,800 RPM, NEMA design B with cast iron frame with copper windings, induction type, with class F insulation and 1.15 Service Factor for normal starting torque and low starting current characteristics, suitable for continuous service. The motors shall not overload at the design condition or at any head in the operating range as specified. Motors shall be suitable for operation using the utility power available specified in part 1 of this section.
2. Motors shall be tested in accordance with provisions of ANSI/IEEE Std. 112, Method B.

B. Drive Transmission

1. Power to pumps transmitted V-belt drive assemblies. The sheave/belt combination shall provide the speed ratio needed to achieve the specified pump operating conditions.
2. Each drive assembly shall utilize at least two V-belts providing minimum a combined safety factor of 1.5. Single belt drives or systems with a safety factor of less than 1.5 are not acceptable. Computation of safety factors shall be based on performance data published by the drive manufacturer.
3. Precise alignment tolerances of the drive assemblies shall be achieved by means of a belt/sheave laser alignment system resulting in the reduction of vibration, accelerated wear, and premature failure.
4. The pump manufacturer shall submit power transmission calculations which document the following:
 - a. Ratio of pump/motor speed.
 - b. Pitch diameter of driver and driven sheaves.
 - c. Number of belts required per drive.
 - d. Theoretical horsepower transmitted per belt, based on vendor's data.
 - e. Center distance between pump and motor shafts.
 - f. Arc-length correction factor applied to theoretical horsepower transmitted.
 - g. Service factor applied to established design horsepower.
 - h. Safety factor ratio of power transmitted/brake horsepower required.

5. Pump drives to be enclosed on all sides by a guard constructed of fabricated steel or combination of materials including expanded, perforated, or solid sheet metal. No opening to a rotating member shall exceed 1/2 inch.
 - a. Guards must be completely removal without interference from any unit component, and shall be securely fastened and braced to the unit base.
 - b. Metal to be free from burrs and sharp edges. Structural joints shall be continuously welded. Rivet spacing on panels shall not exceed five inches. Tack welds shall not exceed four inch spacing.
 - c. The guard shall be finished with one coat of gray W.R. non-lift primer and one coat of orange acrylic alkyd W.R. enamel in accordance with section 3, Color Definitions of ANSI 253.1; Safety Color Code for Marking Physical Hazards.

2.07 Finish

- A. Pumps, piping and exposed steel framework shall be cleaned prior to coating using an approved solvent wipe or phosphatizing cleaner. The part must thoroughly dry before paint application. Open joints shall be caulked with an approved polyurethane sealant. Exposed surfaces to be coated with two coats of a semi gloss white 2-component epoxy/polyamide to a dry film thickness of a minimum of 10 mils (5 mils minimum per coat). Coating shall be a high solids, 2 component epoxy/polyamide semi-gloss white coating for optimum illumination enhancement. The coating shall be corrosion, moisture, oil, and solvent resistant when completely dry. The factory finish shall allow for over-coating and touch-up for 6 months after coating. Thereafter, it will generally require sanding to accept a topcoat or touch-up coating. See Product Data Sheet for additional information.

2.08 ELECTRICAL CONTROL COMPONENTS

- A. The pump station control panel will be tested as an integral unit by the pump station manufacturer. The control panel shall also be tested with the pump station as a complete working system at the pump station manufacturer's facility.
- B. Panel Enclosure
 1. Electrical control equipment shall be mounted within a common NEMA 1 stainless steel, dead front type control enclosures. Doors shall be hinged and sealed with a neoprene gasket and equipped with captive closing hardware. Control components shall be mounted on removable steel back panels secured to enclosure with collar studs.
 2. All control devices and instruments shall be secured to the sub-plate with machine screws and lockwashers. Mounting holes shall be drilled and tapped; self-tapping screws shall not be used to mount and component. All control devices shall be clearly labeled to indicate function.

(Optional Controls and Accessory for **CONTROL PANEL UL LABEL REQUIREMENT)*

C. UL Label Requirement

1. Pump station controls shall conform to third party safety certification. The panel shall bear a serialized UL label listed for "Enclosed Industrial Control Panels". The enclosure, and all components mounted on the sub-panel or control cover shall conform to UL descriptions and procedures.

(Optional Controls and Accessory for **PUMP STATION AND CONTROL PANEL UL LABEL REQUIREMENT)*

D. UL Label Requirement

1. Pump station components and controls shall conform to third party safety certification. The station shall bear a UL label listed for "Packaged Pumping System". The panel shall bear a serialized UL label listed for "Enclosed Industrial Control Panels". The pump station components, panel enclosure, and all components mounted on the sub-panel or control cover shall conform to UL descriptions and procedures.

E. Branch Components

1. All motor branch and power circuit components shall be of highest industrial quality. The short circuit current rating of all power circuit devices shall be a tested combination or evaluated per the National Electrical Code Article 409. the lowest rated power circuit component shall be the overall control panel short circuit rating and shall not be less than the fault current available. The minimum control panel rating shall not be less than 10 kA, rms symmetrical. Control assemblies operating at 120 volts nominal or less may be provided with transformers which limit the fault current and may be rated less than the minimum required short circuit rating.
2. Circuit Breakers and Operating Mechanisms
 - a. A properly sized heavy duty circuit breaker shall be furnished for each pump motor. The circuit breakers must be sealed by the manufacturer after calibration to prevent tampering.
 - b. An operating mechanism installed on each motor circuit breaker shall penetrate the control panel door. A padlockable operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until circuit breakers are in "OFF" position. An additional mechanism(s) shall be provided on the circuit breaker permitting the breaker to be operated and/or locked with the control panel door in the open position.
3. Motor Starters
 - a. 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 "O", "OO", or fractional size 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 shall be easily replaceable without removing the starter from its mounted position. Each starter shall have a metal mounting plate for durability.
4. Overload Relays
 - a. Overload relays shall be solid-state block type, having visual trip indication with trip-free operation. Electrically resetting the overload will cause one (1) normally open and one (1) normally closed isolated alarm/control contact to reset, thus re-establishing a control circuit. Trip setting shall be governed by solid-state circuitry and adjustable current setting. Trip classes shall be 10, 15 and 20. Additional features to include phase loss protection, selectable jam/stall protection and selectable ground fault protection.
 - b. A reset pushbutton, mounted through the control panel door, shall permit resetting the overload relays without opening the door.
5. Phase Monitor
 - a. 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, voltage unbalance, high voltage, and low voltage. An adjustable time delay shall be provided to minimize nuisance trips. The motor(s) shall automatically restart, following an adjustable time delay, when power conditions return to normal.

(Optional Accessory for **SINGLE-PHASE VOLTAGE MONITOR)*

6. Phase Monitor
 - a. The control panel shall be equipped to monitor the incoming power and shut down the pump when required to protect the motor(s) from damage caused by voltage less than 83% of nominal. The motor(s) shall automatically restart when power conditions return to normal.

(Optional Controls and Accessory for **TRANSIENT VOLTAGE SURGE SUPPRESSOR)*



7. Transient Voltage Surge Suppressor
 - a. The control panel shall be equipped with a modular surge arrester to minimize damage to the pump motors and control from transient voltage surges. The suppressor shall utilize thermally protected by heavy duty zinc-oxide varistors encapsulated in a non-conductive housing. Mechanical indicators shall be provided on each phase to indicate protection has been lost. The suppressor

shall have a short circuit current rating of 200,000 Amps and a Maximum Discharge current rating [I_{max}] of 40,000 Amperes. Nominal discharge current [I_n] is 20,000 Amperes. Surge arrester according to UL 1449 3rd Edition, Type 2 component assembly.

(Optional Controls and Accessory for **VOLTAGE ALERT INDICATION)*

8. Voltage Alert Indication
 - a. The control panel shall include a voltage alert indicator to reduce the risk of electrical arc flash by pre-verifying the electrical isolation from outside of the control panel. Hardwired to the main incoming point of termination, the indicator shall be powered by the same voltage that it indicates utilizing redundant circuitry, thereby flashing whenever voltage is present. An eight detector display shall visually alert the presence of dangerous AC or DC potentials occurring between any combination of the monitored input lines.

(Optional Controls and Accessory for **PUMP START DELAY)*

9. Pump Start Delay
 - a. The control circuit for pump #2 shall be equipped with a time delay to prevent simultaneous motor starts.

(Optional Controls and Accessory for **PANEL HEATER)*

10. Panel Heater
 - a. The control panel shall be equipped with a panel heater to minimize the effects of humidity and condensation. The heater shall include a thermostat.

F. Control Circuit

1. A normal duty thermal-magnetic circuit breaker shall protect all control circuits by interrupting control power.
2. Pump mode selector switches shall permit manual start or stop of each pump 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 oil-tight design with contacts rated NEMA A300 minimum.
3. Pump alternation shall be integral to the liquid level controller. Provisions for automatic alternation or manual selection shall also be integral to the liquid level controller.
4. Six digit elapsed time meter shall be shall be displayed on the Integrinex™ Standard operator interface to indicate total running time of each pump in "hours" and "tenths of hours". Pump runtime shall be adjustable and password protected.
5. A high pump temperature protection circuit shall override the level control and shut down 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 the Integrinex™ Standard. If casing temperature rises to a level sufficient to cause damage, the thermostat causes the Integrinex™ Standard to interrupt power to the motor. The Integrinex™ Standard will display an alarm banner indicating the 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 this circuit is not acceptable.
6. 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.
7. The lift station shall be equipped with a 3 KVA stepdown transformer to supply 115 volt, AC, single phase for the control and auxiliary equipment. The primary and secondary side of the transformer 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. An additional mechanism(s) shall be provided on the

circuit breaker permitting the breaker to be operated and/or locked with the control panel door in the open position.

**(Optional Accessory for a 5 KVA AUXILIARY POWER TRANSFORMER)*

8. Auxiliary Power Transformer

- a. The lift station shall be equipped with a 5 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 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. An additional mechanism(s) shall be provided on the circuit breaker permitting the breaker to be operated and/or locked with the control panel door in the open position.

9. Wiring

- a. The pump station, as furnished by the manufacturer, shall be completely wired, except for power feed lines to the branch circuit breakers and final connections to remote alarm devices.
- b. All wiring, workmanship, and schematic wiring diagrams shall comply with applicable standards and specifications of the National Electric Code (NEC).
- c. 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) Hot With Circuit Breaker Open.....Orange
- d. 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.
- e. Motor branch and other power conductors shall not be loaded above the temperature rating of the connected termination. 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 sub-plate shall be bundled and tied. All wires extending from components mounted on door shall terminate at a terminal block mounted on the back panel. All wiring outside the panel shall be routed through conduit.
- f. 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.

10. Conduit

- a. Factory installed conduit shall conform to following requirements:
 - 1) All conduit and fittings to be UL listed.
 - 2) Liquid tight flexible metal conduit to be constructed of smooth, flexible galvanized steel core with smooth abrasion resistant, liquid tight polyvinyl chloride cover.
 - 3) Conduit to be supported in accordance with articles 346, 347, and 350 of the National Electric Code.
 - 4) Conduit shall be sized according to the National Electric Code.

11. Grounding

- a. Station manufacturer shall ground all electrical equipment inside the pump station to the control panel back plate. All paint must be removed from the grounding mounting surface before making final connection.

- b. The contractor shall provide an earth driven ground connection to the pump station at the main grounding lug in accordance with the National Electric Code (NEC).

12. Equipment Marking

- a. Permanent corrosion resistant name plate(s) shall be attached to the control and include following information:
 - 1) Equipment serial number
 - 2) Control panel short circuit rating
 - 3) Supply voltage, phase and frequency
 - 4) Current rating of the minimum main conductor
 - 5) Electrical wiring diagram number
 - 6) Motor horsepower and full load current
 - 7) Motor overload heater element
 - 8) Motor circuit breaker trip current rating
 - 9) Name and location of equipment manufacturer
- b. 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.
- c. 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.

2.09 LIQUID LEVEL CONTROL

- A. The manufacturer of the liquid level control system must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.
- B. The level control system shall start and stop the pump motors in response to changes in wet well level, as set forth herein.
- C. The level control system shall be capable of operating as either an air bubbler type level control system, submersible transducer type system, or ultrasonic transmitter type system.
- D. The level control system shall utilize alternation to select first one pump, then the second pump, then the third pump (if required), to run as lead pump for a pumping cycle. Alternation shall occur at the end of a pumping cycle, or in the event of excessive run time.
- E. The level control system shall utilize an electronic pressure switch 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 electronic pressure switch shall start the motor for one pump 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 electronic pressure switch shall stop this pump. These actions shall constitute one pumping cycle. Should the wet well level continue to rise, the electronic pressure switch shall start the second and/or third pump (if required) when the liquid reaches the "lag pump start level", or "standby pump start level" so that all pumps are operating. These levels shall be adjustable as described below.
 - 1. The electronic pressure switch shall include integral components to perform all pressure sensing, signal conditioning, EMI and RFI suppression, DC power supply and 120 volt outputs. Comparators shall be solid state, and shall be integrated with other components to perform as described below.
 - 2. The electronic pressure switch shall be capable of operating on a supply voltage of 12-24Vdc in an ambient temperature range of -10 degrees C (14 degrees F) through 55 degrees C (131 degrees F). Ingress Protection of IP56 for indoor use with closed cell neoprene blend gasket material. Evaluated by Underwriters Laboratories for Pollution Degree 2 device for U.L. and cU.L. Control range shall be 0 to 33.3 feet of water with an overall repeat accuracy of (plus/minus) 0.1 feet of water. Memory shall be non-volatile. A Battery backed real time clock shall be standard.
 - 3. Eleven optically isolated, user defined digital inputs for pump and alarm status. Rated at 10mA at 24Vdc. Eight digital output relays (mechanical contacts), configurable for pump start/stop or alarms. Three relays rated at 12 Amp @ 28Vdc and 120Vac, five relays rated at 3 Amp @ 30Vdc and 120Vac. The electronic pressure switch shall consist of the following integral components: pressure sensor, display, electronic comparators, digital inputs and digital output relays.

- a. The internal pressure sensor shall be a strain gauge transducer and shall receive an input pressure from the air bubbler system. The transducer shall convert the input to a proportional electrical signal for distribution to the display and electronic comparators. The transducer output shall be filtered to prevent control response to level pulsations or surges. The transducer range shall be 0-14.5 PSI, temperature compensated from -40 degrees C (-40 degrees F) through 85 degrees C (185 degrees F), with a repeat accuracy of (plus/minus) 2.5% full scale about a fixed temperature. Transducer overpressure rating shall be 3 times full scale.
 - b. The electronic pressure switch shall incorporate a digital back lighted LCD panel display which, upon operator selection, shall indicate liquid level in the wet well, and pump status indication for up to 3 pumps. The display shall include a 128 x 64 bit resolution LCD 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.
 - c. Level adjustments shall be electronic comparator set-points to control the levels at which the lead, lag and standby pumps start and stop. Each of the level settings shall be easily adjustable with the use of membrane type switches, and accessible to the operator without opening any cover panel on the electronic pressure switch. 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 or introduction of pressure to the electronic pressure switch.
 - d. Each digital input can be programmed as pump run, pump HOA, pump high temp, pump moisture/thermal, starter failure (FVNR, RVSS, VFD), and phase failure. Inputs are used for status and alarm indication.
 - e. Each output relay in the electronic pressure switch shall be hard contact mechanical style. Each relay input shall be optically isolated from its output and shall incorporate zero crossover switching to provide high immunity to electrical noise. Each output relay shall have an inductive load rating equivalent to one NEMA size 3 contactor. A pilot relay shall be incorporated for loads greater than a size 3 contactor.
4. The electronic pressure switch shall be equipped with alarm banners with time and date history for displaying alarm input notification. Alarm history will retain a 16 of the most recent alarm events.
 5. The electronic pressure switch shall be equipped with pump start/stop and alarm input delay(s) that have an adjustable delay set points.
 6. An Antiseptic function with a built in timer shall be incorporated in the electronic pressure switch to prevent the well from becoming septic.
 7. The electronic pressure switch shall be capable of jumping to next available pump if current pump is out of service due to pump failure or manual selection. Circuit design in which application of power to the lag pump motor starter is contingent upon completion of the lead pump circuit shall not be acceptable.
 8. The electronic pressure switch shall be equipped with a simulator system capable of performing system cycle testing functions.
 9. The electronic pressure switch shall be capable of calculating and displaying pump elapse run time. The elapse run time is resettable and adjustable.
 10. The electronic pressure switch shall have internal capability of providing automatic simplex, duplex, and triplex alternation, manual selection of pump sequence operation, and alternation in the event of 1-24 hours of excessive run time.
 11. The electronic pressure switch shall be equipped with a security access code to prevent accidental set-up changes and provide liquid level set-point lock-out. The supervisor access code is adjustable.
 12. The electronic pressure switch shall be equipped with one (1) 0-33 ft. W.C. input, one (1) scalable analog input of either 0-5Vdc, or 4-20mA, and one (1) scalable analog output of either 0-5Vdc, 0-10Vdc or 4-20mA. Output is powered by 10-24Vdc supply. Load resistance for 4-20mA output shall be 100-1000 ohms.

13. The electronic pressure switch shall include a DC power supply to convert 120Vac control power to 12 or 24Vdc power. The power supply shall be 500 mA (6W) minimum and be UL listed Class II power limited power supply.
14. The electronic pressure switch shall be equipped with an electronic comparator and mechanical output relay to alert maintenance personnel to a high liquid level in the wet well. An alarm banner, visible on the front of the controller, shall indicate that a high wet well level exists. The alarm signal shall be maintained until the wet well level has been lowered and the circuit has been manually reset. High water alarm shall be furnished with a dry contact wired to terminal blocks.
15. The electronic pressure switch shall be equipped with an electronic comparator and mechanical output relay to alert maintenance personnel to a low liquid level in the wet well. An alarm banner, visible on the front of the controller, shall indicate that a low wet well level exists. The alarm signal shall be maintained until the cause for the low wet well level has been corrected and the circuit has been manually reset. A low liquid level condition shall disable all pump motors. When the wet well rises above the low level point, all pump motors shall be automatically enabled. Low water alarm shall be furnished with a dry contact wired to terminal blocks.

Optional Accessory for **Integrinex Standard Analog Output Transient Voltage Surge Suppression*

- ✓ 16. Integrinex Standard Analog Output circuit will be furnished with transient voltage surge suppression to protect related equipment from induced voltage spike from lighting.
- F. 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 a membrane style button integral to the Integrinex Standard level controller.

G. Air Bubbler System

1. The level control system shall be the air bubbler type, containing air bubbler piping which extends into the wet well. A pressure sensor contained within the electronic pressure switch shall sense the air pressure in this piping to provide wet well level signals for the remainder of the level control system.
2. Two vibrating reed, industrial rated, air pumps shall be furnished to deliver free air at a rate of approximately 5 cubic feet per hour and a pressure not to exceed 7 psi. Liquid level control systems utilizing air compressors delivering greater quantities of air at higher pressures, requiring pressure reducing valves, air storage reservoirs, and other maintenance nuisance items will not be acceptable. A selector switch shall be furnished to provide manual alternation of the air pumps. The switch shall be connected in such a manner that either pump may be selected to operate continuously. The selector switch shall be oil-tight design with contacts rated NEMA A300 minimum.
3. An air bell constructed of PVC 3 inches in diameter shall be provided for installation at the outlet of the air bubbler line in the wet well. The air bell shall have a 3/8" NPT tapped fitting for connection to the bubbler line.
4. An air flow indicator gauge shall be provided and connected to the air bubbler piping to provide a visual indication of rate of flow in standard cubic feet per hour.

Optional Controls and Accessory for **ALARM LIGHT EXTERNAL*

✓ H. Alarm Light (External)

1. Station manufacturer will supply one 115 VAC alarm light fixture with vapor-tight shatter resistant red globe, 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.

Optional Controls and Accessory for **ALARM HORN EXTERNAL*

- ✓ I. Alarm Horn (External)
 - 1. Station manufacturer will supply one 115 VAC weatherproof alarm horn with projector, conduit box, and mounting base. The design must prevent rain water from collecting in any part of the horn. The alarm horn will be shipped loose for installation by the contractor.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Contractor shall off-load equipment at installation site using equipment of sufficient size and design to prevent injury or damage. Station manufacturer shall provide written instruction for proper handling. Immediately after off-loading, contractor shall inspect complete pump station and appurtenances for shipping damage or missing parts. Any damage or discrepancy shall be noted in written claim with shipper prior to accepting delivery. Validate all station serial numbers and parts lists with shipping documentation. Notify the manufacturer's representative of any unacceptable conditions noted with shipper.

3.02 INSTALLATION

- A. Install, level, align, and lubricate pump station as indicated on project drawings. Installation must be in accordance with written instructions supplied by the manufacturer at time of delivery.
- B. Suction pipe connections are vacuum tight. Fasteners at all pipe connections must be tight. Install pipe with supports and thrust blocks to prevent strain and vibration on pump station piping. Install and secure all service lines (level control, air release valve or pump drain lines) as required in wet well.
- C. Check motor and control data plates for compatibility to site voltage. Install and test the station ground prior to connecting line voltage to station control panel.
- D. Prior to applying electrical power to any motors or control equipment, check all wiring for tight connection. Verify that protective devices (fuses and circuit breakers) conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.
- E. After all anchor bolts, piping and control connections are installed, completely fill the grout dam in the pump station base with non-shrink grout.

3.03 FIELD QUALITY CONTROL

- A. Operational Test
 - 1. Prior to acceptance by owner, an operational test of all pumps, drives, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified operating characteristics.
 - 2. After construction debris and foreign material has been removed from the wet well, contractor shall supply clear water volume adequate to operate station through several pumping cycles. Observe and record operation of pumps, suction and discharge gage readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment, test manual control devices, and automatic control systems. Be alert to any undue noise, vibration or other operational problems.
- B. Manufacturer's Start-up Services
 - 1. Coordinate station start-up with manufacturer's technical representative. The representative or factory service technician will inspect the completed installation. They will calibrate and adjust instrumentation, correct or supervise correction of defects or malfunctions, and instruct operating personnel in proper operation and maintenance procedures.

3.04 CLEANING

- A. Prior to acceptance, inspect interior and exterior of pump station for dirt, splashed material or damaged paint. Clean or repair accordingly. Remove from the job site all tools, surplus materials, scrap and debris.

3.05 PROTECTION

- A. The pump station should be placed into service immediately. If operation is delayed, drain water from pumps and piping. Open motor circuit breakers and protect station controls and interior equipment from cold and moisture. Station is to be stored and maintained per manufacturer's written instructions.

END OF SECTION

SECTION 33 33 13

SANITARY UTILITY SEWERAGE

PART 1 GENERAL

1.01 DESCRIPTION

- A. Work included: Provide Gravity wastewater system as indicated on the plans or as specified herein.
- B. Related work:
 - 1. Other documents affecting work under this section include but are not limited to the General Conditions, Supplementary Conditions, and sections in Division 1 of these specifications.
 - 2. Section 31 22 00 - Grading.
 - 3. Section 31 23 16 - Excavation.
 - 4. Section 31 23 23.13 – Backfill and Compaction.
 - 5. Section 31 23 16.13 - Trenching for Site Utilities.
 - 6. Section 33 05 40 - Casing Pipes for Utilities.

1.02 QUALITY ASSURANCE

- A. Perform work in accordance with utility company requirements.
 - 1. Use required number of workmen that are properly trained and have experience in the crafts and who are completely familiar with the specified requirements herein and the methods for the proper performance of the work specified in this section.
 - 2. All materials specified in this section must be manufactured in the United States of America and properly marked "Made in the USA".

1.03 SUBMITTALS

- A. Comply with Section 01 30 00.
- B. Contractor must provide product data within 14 calendar days after receipt of the Owner's notice to proceed.
- C. Submit specific items:
 - 1. Provide a Materials List for the specific items being provided under this Section.
 - 2. Specifications or other related data outlining compliance with the requirements of this section.

1.04 PRODUCT HANDLING

- A. Comply with Section 01 60 00.

- B. Storage of PVC pipe:
 - 1. PVC pipe must be stored as unit packages as received from the manufacturer prior to use.
 - 2. Pipe units must be staked to prevent deformation to pipe barrel and bells.
 - 3. If a storage period of more than six (6) weeks is required, protect pipe from direct sunlight by covering with opaque material.
- C. Protect PVC pipe from damage by severe impact blows, gouging or cutting by metal surfaces or rocks.

1.05 ORDER AND ACCEPTANCE OF WORK

- A. Contractor must confirm with the engineer regarding which gravity wastewater lines to install first and last.
 - 1. In general, gravity wastewater pipe installation will commence at the outfalls, installation of the wastewater mains and then the installation of any wastewater laterals.
- B. Owner and Engineer reserves right to accept and use any portion of the wastewater piping being installed if it is considered to be in the best interest of the public. Any required permitting to place the wastewater mains in operation will be secured by the Engineer and Owner.

1.06 PROTECTION OF OTHER UTILITIES

- A. Location:
 - 1. The plans illustrate the approximate location of adjacent underground and above ground utilities that are known. Small service lines and or other utility lines are not illustrated and must be located prior to construction.
 - 2. Excavate, locate and expose any existing underground utilities prior to the proposed trenching.
- B. Repair and/or replace any damaged utility line or structure at no additional cost to the project and Owner.

1.07 CONFLICTING UTILITIES

- A. Remove and/or relocate any conflicting utilities, as illustrated on the plans or when directed by the Engineer, at the expense of the Owner.
- B. When changes are made to the existing utilities and the plans indicate to avoid conflicts, the removal and/or relocation of these utilities may be made at no additional cost to the project or Owner.

1.08 JOB CONDITIONS

- A. Work under this Section may require construction or work in a confined space, defined as any space having one or more of the following characteristics:

1. Restricted openings for entry and exit.
 2. Poor natural ventilation.
 3. Areas may not be designed for occupancy over an extended period of time.
- B. In order to perform the work within the confined space areas, the Contractor shall at all times at least have on the job site the following safety equipment:
1. Gas Monitoring Device that can test and detect combustible gas, oxygen deficiency and hydrogen sulfide.
 2. Confined Space access and rescue winch system.
 3. Vent Fan with large diameter vent hose.
 4. Supplied air respirator, MISHA/NIOSH approved type.
 5. Safety harness and lifelines.
- C. This required equipment must be made available for use by the Contractor, for their personnel, the Engineer and Owner if required, for the duration of the project.
- D. All entry into or work within confined spaces will be conducted in accordance 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.

PART 2 PRODUCTS

2.01 GENERAL

- A. All pipe provided for the project shall be observed by the Engineer at the manufacturing facility, within the trench or at any other point of delivery, for rejecting pipe that does not conform to specifications, and that is independent of laboratory testing.
- B. All rejected pipe will be marked by the Engineer for the Contractor's removal and disposal from project site.

2.02 PIPE AND FITTINGS

- A. Any pipe material specified herein may be utilized for the wastewater system construction unless a particular pipe material is indicated on the plans.
- B. Ductile-Iron Pipe and Fittings (DIP):
1. Provide piping in accordance with ASTM A-746 or ANSI A21.50 and A21.51 or AWWA C150 and C151, latest revision.
 2. All mechanical or push-on joints must comply with AWWA/ANSI C111/A21.11 and as modified by AWWA/ANSI C151/A21.51, latest revision.
 3. Provide rubber gaskets and lubricant complying with AWWA/ANSI C111/A21.10, latest revision.
 4. Provide pipe size in accordance with table included herein for depth and bedding conditions.

5. Provide fittings with pressure rating of 150 psi and in accordance with AWWA/ANSI C110/A21.10, latest revision.
 6. Provide a pipe lining in accordance with one (1) of the following:
 - a. Polyethylene lining complying with ASTM D1248, latest revision, with a 40 mil nominal thickness.
 - b. Amine cured Novalac Epoxy polymeric lining, 40 mils nominal thickness. The standards of quality are based on Protecto 401 by Vulcan Painters, Polymer Lining No. 210 by Sauereisen Cements.
- C. Polyvinyl Chloride Pipe and Fittings (PVC):
1. Provide integral wall bell and spigot, minimum of SDR35, complying with ASTM D3033 and D3034 or F-789-82; ASTM D2321, latest revision.
 2. Provide elastomeric gasket joints that provide a watertight seal.
 3. Provide pipe in 12.5 or 20-foot lengths.
- D. Polyethylene Encasement: (Optional)
1. Provide polyethylene encasement of pipe and fittings as illustrated on the plans or specified herein.
 2. The minimum nominal thickness for the encasement is eight (8) mil.
 3. All encasements must be provided in accordance with AWWA C105, latest revision.

2.03 MANHOLES

- A. Use precast manholes:
1. Provide reinforced precast concrete manhole ring and eccentric cone sections complying with ASTM C478, latest revision, at a minimum.
 2. Portland cement must comply with ASTM C150, latest revision, Type II.
 3. Provide a cast base slab monolithically with walls.
 4. For HS-20 traffic loading conditions provide a flat slab top section designed to meet the load requirements.
 5. Cast ladder rungs into the wall of all units.
 - a. Embed a minimum of 3" deep with a maximum spacing of 16".
 6. Manhole sections must be tongue and groove with vulcanized butyl rubber sealant or O-ring rubber gasketed joints.
 7. Provide cast or factory cut pipe opening in manholes:

- a. Provide flexible pipe boot in accordance with ASTM C923M, latest revision.
 - b. Boot must be attached to the wastewater piping with a minimum of two (2) stainless steel straps.
 - c. Any other hardware provided must be stainless steel.
 - d. Provide Kor-N-Seal or equal where required.
8. All lift holes and inserts must be sized to provide a precision fit with the lift devices used to move the manhole sections.
- a. Lift holes cannot penetrate through the manhole wall.
 - b. Grout lift holes when manhole has been installed.
 - c. Comply with OSHA Standard 1926.704, latest revision.
9. Where manhole depth is less than 4'-0" flat slab tops must be provided.
10. Provide epoxy lining as specified in Specification Section 09 97 23.12.
11. Manhole Liner: (Optional liner for wetwells, manholes, etc.)
- a. Provide a High Density Polyethylene (HDPE) concrete protective liner (CPL) in the pump station wetwells, manholes that force mains connect as well as the next manhole downstream of force main receiving manhole, all air release valve manholes and drop manholes.
 - b. Minimum thickness: 2 mm.
 - c. Provide extruded liner in sheets with a minimum 39 anchoring studs per sq. ft. that is manufactured during the extrusion process as one piece with the extruded liner sheet.
 - d. Liner pull out design must meet 112.5/lbs/anchoring stud.
 - e. Overlap all joints with flat liner sheet that is non-anchored and has a minimum thickness of 3 mm.
 - f. All joints must be sealed by means of thermal welding performed by welders certified by the manufacturer.
 - g. Provide sufficient elongation to accommodate up to 1/4" settling cracks.
 - h. The lining must be repairable at any time during the life of the manhole structure.
 - i. A manufacturer-certified fabricator must be utilized to custom fit the liner to the manhole formwork.
 - j. All interior surfaces must be protected, including manhole walls, ceiling, pipe entries and manhole chimney.

- k. The liner and welding rods must be manufactured from the same resins meeting the following properties:

Property Testing Method Unit

Density ASTM D792-86 0.945 g/cm³

MFI (Melt Flow Index) ASTM D1238-88(190/5) g/10 min.

Heat Reversion (Dimensional Stability) ASTM D1638-83 <2%

Yield Stress ASTM D638-89 >2,320 psi

Elongation of Yield ASTM D638-89 >12%

Elongation of Break ASTM D638-89 >200%

Fire Classification UL-94V2

Maximum Working Temperature 140 F

- l. Upon request provide written certification from the manufacturer, stating that the liner meets or exceeds the requirement of this specification.
- m. Accepted products: AgruSure Grip or approved equivalent.

B. Steps: (Not required)

1. Provide polypropylene plastic steps reinforced with 3/8" diameter steel rod, M.S.A. Industries, Inc. Model PS-K, or equal.
2. Provide steps having non-skid top surfaces, safety slope at each end, minimum width of 10" and not less than 5" projection from wall.

C. Exterior joint collar: (Optional)

1. Provide exterior joint collar on all manhole joints with a 7" wide band.
 - a. Provide an outer layer of polyethylene with an under layer of rubberized mastic reinforced with a woven polypropylene fabric.
 - b. Provide a peelable protective paper against the mastic that is removed when the collar is applied to the joint.
 - c. Design the collar so that when it is applied around the joint the ends overlap at least 6".
 - d. Within the collar, locate two steel straps 5/8" wide 3/4" from each edge of the band.
 - e. Install the straps in tubes that isolate them from the mastic and allow them to slip freely when tightened around the pipe.
 - f. Design the collar so that when it is applied around the joint the ends overlap at least 6" and when the straps are secured a layer completely covers the straps protecting them from moisture and rust.

2. Approved manufacturers: SealWrap Exterior Joint Sealer as manufactured by Mar-Mac Manufacturing Company or an approved equal.
 3. Approved manufacturers MacWrap Exterior Joint Sealer as manufactured by Mar-Mac Manufacturing Company or an approved equal.
- D. Frames and covers:
1. All gray iron castings must be provided in accordance with ASTM A48, latest revision, Class 30 iron.
 2. Machine all load bearing surfaces.
 3. Provide cover frames weighing not less than 195 lbs. with inside opening between 21" and 24".
 4. Provide circular cover with two (2) pick hole setup and weighing not less than 120 lbs.
 5. Covers must have the words "SANITARY SEWER" cast in the metal.
 6. Provide two (2) finished coats of bitumastic paint on all frames and covers.
 7. Watertight frames and covers with a minimum of four (4) bolts tapped and counter sunk in the cover, must be provided where indicated on the plans.
 - a. A rubber gasket must be provided between frame and cover.
 8. Provide manhole frame and cover from US Foundry Model No. USF 653, or approved equal.
- E. Precast grade rings: (Optional)
1. To adjust the finish grade of manhole covers, use precast grade rings.
 2. Grade Rings cannot be used to extend manholes more than 8-inches vertical.
 3. Precast grade rings must conform to ASTM C478, latest revision.
 4. Provide grade rings with a minimum of 4" in height.
 5. Use cement bricks for cover adjustments less than 4".
- F. Precast inverts: (Optional)
1. Provide precast inverts on all precast manholes.
 - a. Pipe openings shall provide a minimum of 2" in clearance for pipe projecting the interior of the manhole.
 - b. The elevation change inside the manhole from the pipe opening to the invert trough shall be equal to one-half of the Opening ID minus Pipe ID, $\pm 1/4$ ".

2. The crown of small ID pipes must be equal to or greater than the crown of the outlet pipe.
 - a. When the fall between the inlet and the outlet pipes through the manhole is greater than 4", the invert of the trough must be below the inlet pipe invert and aligned horizontally within 1".
 - b. Provide troughs than have a consistent slope from the pipe outlet to the inlets up to 4" fall.
 - 1) The minimum fall through the manhole is 1".
 - 2) The minimum bending radius of the trough centerline-1.5 times the pipe ID
 - 3) When there are two (2) or more channels entering and exiting the manhole, provide a 1/2" radius at the intersection.
 - 4) Provide a minimum concrete thickness of 7" from the bottom of the trough to the bottom of the base.
 - c. Float-finish all benches to provide a uniform 2-1/2" slope, $\pm 1"$, from the highest point at the manhole wall to the low point at invert of trough.
 - 1) A 1/4" radius must be provided at the edge of the bench and trough.
 - d. Fill, depressions, high spots, voids, chips, or fractures over 1/4" in diameter or depth with a sand cement paste and finish to a texture reasonably consistent with the formed surface.

2.04 CLEANOUTS (VERIFY WITH OWNER)

- A. Provide cleanouts on each proposed service line.
 1. Locate cleanouts at the edge of the right-of-way.
- B. Cleanouts must be the same diameter as lines in which they are being installed. No wastewater service lines and cleanouts can be less than 4" in diameter.
- C. Provide Smith #4253, Josam #58860 with XH cast iron top, or approved equal.
- D. Provide ABS cleanout plugs.

2.05 OTHER MATERIALS

- A. Provide any additional materials that may be required for a complete installation of the wastewater mains and service lines not specifically described but may be required for a complete and proper installation, as selected by the Contractor and approved by the Engineer.

PART 3 EXECUTION

3.01 LAYING OUT WORK

- A. Provide all materials, labor, instruments, etc. required to lay out the proposed wastewater system and complete the installation.
- B. Cut sheets must be prepared under direct supervision of the Engineer.
- C. Contractor must verify all manhole invert calculations prior to the layout of the wastewater system, and the contractor will be held responsible for any errors that might have been avoided.
- D. Once errors have been determined, notify the Engineer immediately, in order that proper corrections may be made.

3.02 LOCATION OF WASTEWATER MAINS IN RELATION TO POTABLE WATER MAINS

- A. Wastewater lines must conform to South Carolina Standards for Wastewater Facility Construction R.61-67 section 67-300 paragraph A.14.
- B. There shall be no physical connections between a public or private potable water supply system and a wastewater, or appurtenances thereto which may permit the passage of any sewage or polluted water into the potable supply. No. potable water pipe shall pass through or come into contact with any part of a wastewater manhole.
- C. In areas where the wastewater lines are not located clearly by dimensions on the drawings, locate the wastewater lines:
 - 1. Horizontal and Vertical Separation: Wastewater Mains shall be laid at least 10-feet horizontally from any existing or proposed potable water main or water service line. The distance shall be measured edge to edge. In cases where it is not practical to maintain a 10-foot separation, SCDHEC may allow deviation on a case-by-case basis, if supported by data from the design engineer. Such deviation may allow installation of the wastewater main closer to the potable water main, provided that the potable water main is in a separate trench or on an undisturbed earth shelf located on one side of the wastewater main and at an elevation so the bottom of the potable water main is at least 18-inches above the top of the wastewater main.
 - 2. Crossings: Wastewater mains crossing potable water mains shall be laid to provide a minimum vertical separation of 18-inches between the outside of the potable water main and the outside of the wastewater main. This shall be the case where the potable water main is either above or below the wastewater main. Where a new wastewater main crosses a new potable water main, a full length of pipe shall be used for both the wastewater main and the potable water main and the crossing shall be arranged so that the joint of each main shall be as far as possible from the point of crossing and each other. Where a potable water main crosses under a wastewater main, adequate structural support shall be provided for the wastewater main to prevent damage to the potable water main while maintaining line and grade as stated Paragraph 5 below.
 - 3. Special Conditions: When it is impossible to obtain the distances specified above, SCDHEC may allow an alternative design and any alternative shall:
 - a. maximize the distances between the wastewater mains and the potable water main and the joints of each;

- b. use pipe materials which meet the requirements as specified in Regulation 61-58.4 (D)(1) for the wastewater main; and
 - c. allow enough distance to make repairs to one of the mains without damaging the other.
4. No potable water main shall pass through or come into contact with any part of a wastewater manhole.
 5. In locations where the water main crosses under a wastewater main, fully encase the wastewater pipe for a distance of 10' on each side of the water line pipe or use an acceptable pressure pipe that has no joint closer than 3' horizontally from the crossing. The pressure pipe used must be tested to verify water tightness prior to backfilling.
 6. In locations where concrete encasement is utilized, provide no less than a 4" thickness on all sides of the pipe, including pipe joint locations.

3.03 WASTEWATER PIPE INSTALLATION

- A. All wastewater mains shall be constructed with a minimum of 3-feet of cover, unless justified by the applicant and approved by SCDHEC (e.g., use of ductile iron pipe may have cover less than 3-feet).
- B. Complete all trenching, backfill and compaction for the work under this section in accordance with provisions outlined in Sections 31 23 16.13 and 31 23 23.33 of these specifications and the following requirements:
 1. Maximum trench widths, depths and bedding methods.
 - a. Maximum trench width dimensions refer to the critical trench section of the pipe excavation.
 - b. Install all proposed wastewater lines in accordance with tables listed below for the proposed pipe sizes and how they relate to depths of cut and class of bedding.
 - c. In areas where the trenches are excavated beyond specified widths, or trench walls collapse, install wastewater lines in accordance with the next improved class of bedding with no additional cost to the project or Owner.
 - d. Any additional costs associated with any special bedding and tamping beyond normal conditions must be included in unit prices bid for gravity wastewater lines.
 2. Polyvinyl Chloride Pipe (SDR35):
 - a. Bedding and Haunching Materials
 - 1) Crushed stone utilized for bedding and hunching shall meet the requirements of the South Carolina Department of Transportation Specifications. Stone size shall be between No. 57 and No. 4, inclusive.

- b. Earth materials shall be suitable materials selected from the trench excavation. Suitable materials shall be clean and free of rock larger than 2-inches at its largest dimension, organics, cinders, stumps, limbs, frozen earth or mud, man-made wastes and other unsuitable materials. Should the material excavated from the trench be saturated, the saturated material may be used as earth material, provided it is allowed to dry properly and it is capable of meeting the specified compaction requirements. When necessary, earth bedding and haunching materials shall be moistened to facilitate compaction by tamping.
- c. Initial Backfill
 - 1) Initial backfill material shall be earth materials or crushed stone as specified for bedding and haunching materials. Soil shall be tamped to 90% of Standard Proctor Density (ASTM D698).
 - 2) Earth materials utilized for initial backfill shall be suitable materials selected from materials excavated from the trench. Suitable materials shall be clean and free of rock larger than 2-inches at its largest dimension, organics, cinders, stumps, limbs, frozen earth or mud, man-made wastes and other unsuitable materials. Should the material excavated from the trench be saturated, the saturated material may be used as earth material, provided it is allowed to dry properly and it is capable of meeting the specified compaction requirements. When necessary, initial backfill materials shall be moistened to facilitate compaction by tamping. If materials excavated from the trench are not suitable for use as initial backfill material, provide select material conforming to the requirements of this Section.
- d. Final Backfill
 - 1) Final backfill material shall be general excavated earth materials, shall not contain rock larger than 2-inches at its greatest diameter, cinders, stumps, limbs, man-made wastes and other unsuitable materials. If materials excavated from the trench are not suitable for use as final backfill material, provide select material conforming to the requirements of this Section.
 - 2) In areas not used for streets or driveways, carefully refill in layers not exceeding 8 inches in thickness and thoroughly tamp with hand tamps to one foot above the top of the pipe. Finish filling by machine without tamping. As trench settles, bring back to grade by adding more material. Maintain trenches in safe condition at all times. Restore all special grassing and shrubbery, fences, etc., to original condition. The remaining backfill shall be thoroughly compacted in 8 inch layers to at least 95% (percent) of the Standard Proctor Density (ASTM D698).
 - 3) In streets, roadways and driveways, carefully refill in layers not exceeding 8 inches in thickness and thoroughly tamp with hand tamps to one foot above the top of the pipe. The remaining backfill shall be thoroughly compacted in 8 inch layers to at least 98% (percent) of the Standard Proctor Density (ASTM D698).

- 4) Backfilling and tamping work in state highway right-of-ways and streets under jurisdiction of the State Highway Department will be in accordance with the State's Department of Transportation's policy and procedure for accommodation of utilities.
- e. Concrete
- 1) Concrete for bedding, haunching, initial backfill or encasement shall have a compressive strength of not less than 3,000 psi, with not less than 5.5 bags of cement per cubic yard and a slump between 3 and 5-inches. Ready-mixed concrete shall be mixed and transported in accordance with ASTM C 94. Reinforcing steel shall conform to the requirements of ASTM A 615, Grade 60.
- a. Outlined below are the bedding and tamping requirements for the Classes A, B, C and D:
- 1) Class A Bedding shall consist of a continuous concrete cradle as determined by the Engineer.
 - 2) Class B Bedding: The pipe shall be bedded with No. 57 stone bedding material placed on the trench foundation. The bedding shall have a minimum thickness beneath the pipe of 4 inches or one-eighth of the outside diameter of the pipe, whichever is greater, and shall extend up the side to the springline. Initial backfill from the pipe horizontal centerline to a level not less than 12 inches above the top of the pipe and shall be bedding material or carefully placed native soil, compacted to 90% of Standard Proctor Density. The final backfill of the soil to ground surface shall be compacted to the specified density.
 - 3) Class C Bedding: The pipe shall be bedded in No. 57 stone bedding material placed on the trench foundation. The bedding shall have a minimum thickness beneath the pipe of 4 inches or one-eighth of the outside diameter of the pipe, whichever is greater, and shall extend up the sides of the pipe one-sixth the outside diameter of the pipe. Initial backfill between the top of haunching and a point 12 inches above the top of pipe shall be compacted to 90% of Standard Proctor Density. The final backfill of the soil to ground surface shall be compacted to the specified density.
 - 4) Class D Bedding is when the trench is excavated to grade and the bell holes are dug, and the pipe bears uniformly upon the trench foundation. Soil is tamped to 90% of Standard Proctor Density around the pipe and to a point 12 inches above the pipe. The final backfill of the soil to ground surface shall be compacted to the specified density.
3. Drain stops:
- a. Drain stops are to be installed along the proposed wastewater piping at 100' intervals when Class B and Class C beddings are utilized.
 - b. Construct drain stop out of compacted soil 2' long.

- c. All water must be removed from excavation prior to the installation of any drain stops.
- C. Pipe Installation:
- 1. General:
 - a. All proposed piping must be protected during handling. Remove any debris from the inside of any piping being installed.
 - b. Install piping from the outfall upstream with the pipe spigot ends pointing in direction of flow.
 - c. Each section of wastewater pipe must be installed to the grade and lines as illustrated of the plans to provide a uniform invert.
 - d. Be sure that all piping installed is clear of any debris before installation.
 - e. Before joining pipes together, make sure that all surface are clean and dry.
 - f. Provide gasket lubricants as recommended by the pipe manufacturer.
 - g. All joints should be fit, joined and adjust as necessary to meet the required tightness.
 - h. Ductile-iron pipe:
 - 1) Provide Class D bedding limiting the maximum pipe size to 24" and Class to 52 at a depth of 14'.
 - 2) Install piping in accordance with AWWA C600, latest revision unless otherwise noted herein.
 - i. Polyvinyl chloride pipe:
 - 1) Provide Class B or better bedding shall be used for all PVC gravity wastewater lines.
 - 2) Install piping in accordance with ASTM D2321, latest revision, unless otherwise noted herein.
 - j. When defective pipe materials are noted, remove and replace with approved pipe materials at no additional cost to the project or Owner.

3.04 MANHOLE INSTALLATION

- A. Set the base of each manhole level so that all walls will be plumb and level.
- B. All manhole bells and spigots must be cleaned.
- C. Provide joint sealer or a ring gasket to all wall section(s) that are set firmly in place to provide watertight joints.
- D. Manhole steps must align in both the cone and riser section of the manhole.
- E. Connect pipe boots to piping utilizing dual stainless steel straps.

- F. Provide grout for all lift holes installing the grout from the outside. Use non-shrink grout.
- G. Liner installation:
 - 1. Install manhole liner in accordance with manufacturer's recommendations.
 - 2. Liner welding must be performed by welders certified by the manufacturer.
 - 3. Provide a one-piece monolithic concrete protective liner system once welded.
 - 4. The following are approved welding techniques:
 - a. Extrusion welding.
 - b. Wedge welding.
 - c. Butt welding.
 - d. Hot air welding.
 - 5. Testing and supervision of the installation and welding of the liner system must be checked and approved by qualified staff only by visually inspecting and by Spark Testing all welded joints.
- H. Install exterior joint collar.
 - 1. Install in accordance with manufacturer's recommendations.
 - 2. Only on a clean surface.
 - 3. The protective paper must be removed from the joint collar and the band placed around the manhole with the mastic side against the manhole and spanning the joint.
 - 4. The exposed strap must be covered with the closing flap.
 - 5. Secure the steel straps with only manufacturer's recommended tools.
- I. Form the invert channels directly in the concrete of the manhole base, with mortar, or by laying full section sewer pipe through the manhole and breaking out the top half after surrounding concrete has hardened. Smooth the floor of the manhole outside of the channels and slope toward the channels at not less than 1" per foot and no more than 2" per foot. (Only if precast inverts are not used)
- J. Install manhole tops using precast grade rings.
- K. Manhole top elevations shall be greater than or equal to the 50-year flood elevation, unless watertight covers are provided.

3.05 DROP MANHOLES

- A. Place drop manholes where required on the plans and construct in accordance with the details illustrated on the wastewater detail sheet.
- B. Drop manholes are required where the invert differential is 24-inches or more.

3.06 CONNECTIONS TO EXISTING SYSTEM

- A. When constructing a new manhole over an existing wastewater line, construct channels in base of new manhole leaving the existing wastewater line in operation then cut the upper half of existing pipe.
- B. When connecting to existing manholes, temporarily block and/or divert wastewater flows, and use high-early strength cement for mortar to form the proper channels within the existing manhole while keeping the existing manhole in operation or minimize any disruption in service.

3.07 INSTALLATION IN CASING PIPES

- A. Install wastewater lines where indicated on the plans in casing pipe complying with Section 33 05 40 of these specifications.

3.10 INSPECTIONS AND TESTING

- A. General:
 - 1. All wastewater lines will be visually inspected, tested and gauged for infiltration and/or exfiltration.
 - 2. Any visible leaks within the new wastewater system shall be repaired.
 - 3. Any broken, cracked or mislaid pipe must be corrected prior to testing and approval.
 - 4. All repairs to the new wastewater system shall be conducted at no additional cost to the project or Owner.
 - 5. Expense of all testing will be borne by the Contractor.
- B. Construction observation:
 - 1. As each section or blocks of wastewater lines are completed, clean and prepare for observation.
 - 2. Each section piping between new manholes shall show a full circle of light when viewed from either end.
- C. Deflection tests:
 - 1. Deflection tests are to be performed on all PVC pipes and in the presence of the Engineer.
 - 2. Perform deflection testing once all final backfill, and compaction has been completed and in place for a period of twenty (20) days. Do not place the new wastewater system into operation before the permit to operate has been obtained.
 - 3. All deflection tests must be conduct using a rigid ball or mandrel that have a diameter equal to 95% of the inside diameter of the pipe.
 - 4. Mechanical pulling devices cannot be utilized for the deflection tests.

5. Any pipes tested that exceeds a deflection of 5% will need to be exposed, observed and replaced.
- D. Infiltration tests:
1. Infiltration tests are to be provided using V-notch weir, or by direct measurement prior to allowing discharges in the wastewater line.
 2. Seal the end of the wastewater line at upstream structure to prevent the infiltration of water.
 3. If well points are being utilized to control groundwater, discontinue this operation for at least three (3) days prior to testing.
 4. All gravity wastewater mains shall be designed and specified such that the leakage outward (exfiltration) or inward (infiltration) shall not exceed 200-gallons per inch of pipe diameter per mile per day. Air test may be utilized in lieu of an infiltration/exfiltration test, if approved by SCDHEC. Air testing shall conform to ASTM F-1417 for PVC pipe and ASTM C828 for DIP and Concrete Pipe.
 5. All tests must be conducted in the presence of the Engineer, and provide at least five (5) days' notice in advance of testing.
- E. Air testing:
1. Where wastewater lines are installed above the groundwater table, provide air testing in accordance with ASTM C828, latest revision for ductile iron and concrete pipe, and ASTM F1417 for PVC pipe.

3.11 MEASUREMENT AND PAYMENT

- A. All work under completed under this Section will be measured and paid for as follows:
- B. Wastewater piping will be measured from center to center of manholes and payment will be made at the unit price per "linear foot" as stated in the Bid Form, and shall include cost of excavation, bedding, backfilling, cleanup, testing, etc.
- C. Manholes will be paid for at the unit price "each" as stated in the Bid Form, which shall include all costs of excavation, backfilling, materials, standard frame and cover, etc.
- D. Concrete encasement will be paid for at the unit price per "linear foot" of concrete as stated in the Bid Form, such price to be paid in addition to the price per linear foot of wastewater pipe. The unit price stated in the Bid Form shall include the costs for any additional depth of excavation, the furnishing of concrete blocking, and the laying of pipe to line and grade on the blocking.

END OF SECTION

SECTION 33 39 13

SANITARY UTILITY SEWERAGE MANHOLES, FRAMES AND GRATES

PART 1 GENERAL

1.01 DESCRIPTION

- A. The work required under this section consists of all materials, accessories, equipment, tools, and labor required to construct and/or place precast concrete manholes, where shown on the drawings.
- B. Manholes shall be constructed of specified materials to the sizes, shapes and dimensions, and at the locations shown on the plans or as otherwise directed by the Engineer. Generally, the height of manholes shall be such that the top of the manhole frame will be at the finished grade of the pavement or ground surface for manholes located in pavement, in road or street rights-of-ways or in maintained grounds. In areas other than above, the top of the manhole shall be 2 to 4 inches above the finish ground level.

1.02 RELATED SECTIONS

- A. Section 03 30 00 - Cast-In-Place Concrete.
- B. Section 03 40 00 – Precast Concrete.
- C. Section 09 97 23.12 – Manhole Lining

1.03 REFERENCES

- A. ASTM A 48 - Standard Specification for Gray Iron Castings.
- B. ASTM C 55 - Standard Specification for Concrete Brick.
- C. ASTM C 62 - Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale).
- D. ASTM C 144 - Standard Specification for Aggregate for Masonry.
- E. ASTM C 270 – Standard Specification for Mortar for Unit Masonry.
- F. ASTM C 478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.
- G. ASTM C 923 - Standard Specification for Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes and Laterals.
- H. IMIAWC (CW) - Recommended Practices & Guide Specifications for Cold Weather Masonry Construction; International Masonry Industry All-Weather Council. ASTM C 1244 - Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test.

1.04 SUBMITTALS

- A. Shop Drawings: Indicate manhole locations, elevations, piping sizes and elevations of penetrations.
- B. Product Data: Provide manhole covers, component construction, features, configuration and dimensions.

1.05 QUALITY ASSURANCE

Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Maintain materials and surrounding air temperature to minimum 50 degrees F (10 degrees C) prior to, during, and 48 hours after completion of masonry work.
- B. Cold Weather Requirements: Comply with recommendations of IMIAWC (CW).

PART 2 PRODUCTS

2.01 MATERIALS

- A. Manhole Sections: Reinforced precast concrete in accordance with ASTM C 478, with resilient connectors complying with ASTM C 923.
- B. Manhole Sections and Joints: Water tight joints for precast manhole sections, using rubber gaskets for sealing the joints shall be in accordance with ASTM C 443.
- C. Manhole Boots: Shall be NPC Kor-N-Seal connectors or approved equal.
- D. Integral Steps: Fiber reinforced plastic in accordance with ASTM D 3753 (Not required).
- E. Concrete: As specified in Section 03 30 00 or 03 40 00.
- F. Concrete Reinforcement: As specified in Section 03 30 00 or 03 40 00.
- G. Brick: Shall conform to applicable requirements of ASTM C62 Grade NW.
- H. Mortar: Shall be a 3:1 sand-cement mix.

2.02 COMPONENTS

- A. Ring and Cover: ASTM A 48, Class 30B cast iron construction, machined flat bearing surface, removable lockable cover (Bolted Watertight Cover) or removable non-lockable cover (non-bolted), closed cover design; sealing gasket; cover molded with identifying name provided by the owner. Use USF 367 for (Bolted Watertight Standard) Cover or approved equal. Or use U.S. Foundry (USF) 360-E Ring and Cover Series or approved equal for (non-bolted) covers. See plans for frame and cover requirements.
- B. Manhole Steps: Polypropylene safety steps meet to ASTM A-615 and ASTM C-478, AASHTO M-199 and all OSHA specifications. The 1/2-inch grade 60 steel reinforcing bar meets ASTM A-615. Polypropylene rungs shall be 1 inch diameter or approved equal. (Not required).
- C. Manhole Boots: Rubber boots shall be designed and manufactured to meet or exceed the requirements of ASTM C-923 "Standard Specification for Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes and Laterals". The rubber seal shall be made from a resilient rubber compound, which conforms to ASTM C923. The pipe clamp shall be manufactured from 304 series non-magnetic stainless steel, which conforms to ASTM C923 and ASTM A167.

2.03 CONFIGURATION

- A. Construction: Cylindrical base, vertical sections with eccentric cone top section with tongue and groove joints.
- B. Shape: Cylindrical unless otherwise noted on the plans.
- C. Clear Inside Dimensions: 48 inch diameter or as indicated on the plans.
- D. Design Depth: As indicated on the plans.
- E. Clear Cover Opening: Shall be 20-5/8" to 22-1/2".
- F. Pipe Entry: Provide openings as indicated on the plans.
- G. Steps: Set every 15 inches as indicated on the plans. (Not required)

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify items provided by other sections of work are properly sized and located.
- B. Verify that built-in items are in proper location, and ready for roughing into work.
- C. Verify excavation for manholes is correct.

3.02 MANHOLES

- A. All manhole sections shall be manufactured in accordance to ASTM C-478.
- B. Place manhole sections plumb and level, trim to correct elevations.
- C. Form and place manhole cylinder plumb and level, to correct dimensions and elevations.
- D. All manholes base sections shall have preformed inverts cast per the plans.
- E. The manhole base shall be set on an 8 inch (minimum thickness) mat of No. 57 stone or as shown on the construction drawings.
- F. Set frames and covers to correct elevations and properly anchor to the masonry. Where manholes are constructed in paved areas, the top surface of the frame and cover shall be tilted to conform to the exact slope, crown and grade of the existing or proposed pavement.
- G. Installation for the step can be cast in place or driven into pre-formed or drilled hole. The step will resist pullout forces of over 1500 lbs. (Not required)

3.03 MASONRY WORK

- A. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- B. Lay masonry units in running bond. Course one unit and one mortar joint to equal 8 inches.
- C. Form concave mortar joints.
- D. Lay masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.

- E. Install joint reinforcement 16 inches on center.
- F. Place joint reinforcement in first and second horizontal joints above base pad and below cover frame opening.

3.04 TESTING

- A. Leakage Testing: Testing shall be conducted for each precast structure or manhole in accordance with ASTM C 1244 - Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test.:

Vacuum Testing: Manholes shall be tested after assembly and prior to backfilling. Stub outs, manhole boots and pipe plugs shall be secured to prevent movement while the vacuum is drawn. Installation and operation of vacuum equipment and indicating devices shall be in accordance with equipment specifications for which performance information has been provided by the manufacturer and approved by the Engineer. A measured vacuum of 10 inches of mercury (-4.91 psi) shall be established in the manhole. The time for the vacuum to drop to nine inches of mercury (-4.42 psi) shall be recorded. Acceptance standards for leakage shall be established from the elapsed time for negative pressure change from 10 inches to 9 inches of mercury. The maximum allowable leakage rate and instructions for a four foot diameter manhole shall be in accordance with the following:

- B. Testing Instructions:

1. Testing is done after complete assembly of the manhole.
2. The manhole to pipe connection should be a flexible connector, such as Kor-N-Seal or equivalent
3. All lift holes need to be plugged with a non-shrinking mortar, or equivalent.
4. The seal between the manhole sections shall be in accordance with ASTM-C 923.
5. The contractor must plug the pipe openings, taking care to securely brace the plugs and pipe.
6. With the vacuum tester in place:
7. Inflate the compression band to 40 psi to effect a seal between the vacuum base and the structure.
8. Connect the vacuum pump to the outlet port with the valve open.
9. Draw a vacuum to 10" of Hg. (-4.91 psi) and close the valve.
10. The test is considered passing if the vacuum remains between 9" Hg. and 10" Hg. in a time greater than one minute. If the initial test fails, the contractor can locate the leak, and the appropriate repairs made.

4' dia. Manhole Depth Minimum

Elapsed Time for a
Pressure Change of 1 inch Hg

10 ft. or less	60 seconds
>10 ft. but < 15 ft.	75 seconds
>15 ft. but < 25 ft.	90 Seconds

For manholes five feet in diameter, add an additional 15 seconds and for manholes six feet in diameter, add an additional 30 seconds to the time requirements for four-foot diameter manholes. If the manholes fails the test, necessary repairs shall be made and the vacuum test and repairs shall be repeated until the manhole passes the test. If a manhole joint sealer is completely pulled out during the vacuum test, the manhole shall be disassembled and the sealer replaced.

END OF SECTION

SECTION 33 41 00
STORM DRAINAGE PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Storm drainage piping, fittings, and accessories.
- B. Drop Inlets, Site surface drainage, Detention outlet structure, and Detention basin.

1.02 RELATED REQUIREMENTS

- A. Section 31 23 16 – Excavation
- B. Section 31 23 23.13 – Backfill and Compaction
- C. Section 31 23 23.33 – Control Density Fill
- D. Section 31 23 16.13 - Trenching for Site Utilities
- E. Section 03 30 00 - Cast-in-Place Concrete.

1.03 DEFINITIONS

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

1.04 REFERENCE STANDARDS

- A. AASHTO M 36 - Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains; American Association of State Highway and Transportation Officials; 2003.
- B. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2013a.
- C. ASTM C12 - Standard Practice for Installing Vitrified Clay Pipe Lines; 2013.
- D. ASTM C14 - Standard Specification for Non-reinforced Concrete Sewer, Storm Drain, and Culvert Pipe; 2011.
- E. ASTM C14M - Standard Specification for Non-reinforced Concrete Sewer, Storm Drain, and Culvert Pipe [Metric]; 2011.
- F. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe; 2013a.
- G. ASTM C76M - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe [Metric]; 2013a.
- H. ASTM C425 - Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings; 2004 (Reapproved 2009).
- I. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets; 2012.

- J. ASTM C443M - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric); 2011.
- K. ASTM C700 - Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated; 2011.
- L. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2012.
- M. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; 2011.
- N. ASTM D2729 - Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2011.
- O. ASTM D2751 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings; 2005.
- P. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2008.

1.05 SUBMITTALS

- A. Product Data: Provide data indicating pipe, pipe accessories, and pipe class.
- B. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Project Record Documents:
 - 1. Record location of pipe runs, connections, catch basins, cleanouts, and invert elevations.
 - 2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.06 REGULATORY REQUIREMENTS

- A. Conform to applicable code for materials and installation of the Work of this section.

PART 2 PRODUCTS

2.01 PIPE MATERIALS

- A. Concrete Pipe: Reinforced, ASTM C 76 (ASTM C 76M), Class III with Wall Type A; mesh, Tongue and Groove end joints.
- B. Furnish pipe with joints designed for flexible watertight gaskets.
- C. Reinforced Concrete Pipe Joint Device: ASTM C443 (ASTM C443M) rubber compression gasket joint.

2.02 CATCH BASIN, TRENCH DRAIN, CLEANOUT AND AREA DRAIN COMPONENTS

- A. Precast drop inlets, catch basins, outlet structures, etc. shall be as manufactured by Tindall Concrete Products, Inc. or approved equal units by others
- B. All other precast structures (i.e., headwalls, flared end sections, etc.) shall be approved by Engineer prior to installation.
- C. Use precast manholes:
 - 1. Provide reinforced precast concrete ring and eccentric cone sections complying with ASTM C-478 and the following.
 - 2. Use Portland cement complying with ASTM C-150, Type II.
 - 3. Cast ladder rungs into the units.
 - 4. Provide tongue and groove or O-ring rubber gasketed joints.
 - 5. Use vulcanized butyl rubber sealant with tongue and groove joints.
 - 6. Provide flat slab tops where manhole depth is less than 4'0".
- D. Steps:
 - 1. Use aluminum or plastic steps.
 - 2. Provide steps having non-skid top surfaces, safety stops at each end, minimum width of 10" and not less than 5" projection from wall.
 - 3. Aluminum steps shall support 1000-pound load at center with no deformation, coat embedded ends with bituminous paint.
 - 4. Provide polypropylene plastic steps reinforced with 3/8" diameter steel rod, M.S.A. Industries, Inc. Model PS-K, or approved equal.
- E. Frames and covers:
 - 1. Provide gray iron castings, complying with ASTM A 48, Class 30 iron.
 - 2. Machine all bearing surfaces.
 - 3. Provide frames weighing not less than 195 lbs. with inside opening between 21" and 24".
 - 4. Provide circular cover with two "pick" holes and weighing not less than 120 lbs.
 - 5. Covers to conform to Lexington County standards.
 - 6. Coat frames and covers with two (2) shop coats of bitumastic paint.
 - 7. Provide watertight covers, where indicated, conforming to above requirements and with frame tapped for four bolts, countersunk in cover.
 - a. Provide rubber gasket between frame and cover.

2.03 BEDDING AND COVER MATERIALS

- A. Bedding: As specified in Section 31 23 23.13 – Backfill and Compaction.
- B. Cover: As specified in Section 31 23 23.13 – Backfill and Compaction.

2.04 OTHER MATERIALS

- A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

PART 3 EXECUTION

3.01 TRENCHING

- A. See Section 31 23 16.13 – Trenching for Site Utilities for additional requirements.
- B. Hand trim excavation for accurate placement of pipe to elevations indicated.
- C. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

3.02 INSTALLATION – PIPE

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.
- B. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal watertight.
 - 1. Plastic Pipe: Also comply with ASTM D2321.
- C. Lay pipe to slope gradients noted on layout drawings; with maximum variation from true slope of 1/8 inch in 10 feet.
- D. Connect to building storm drainage system, foundation drainage system, and utility/municipal sewer system.
- E. Make connections through walls through sleeved openings, where provided.
- F. Connect to building collection pits, through installed sleeves.

3.03 INSTALLATION - CATCH BASINS, TRENCH DRAINS AND CLEANOUTS

- A. Form bottom of excavation clean and smooth to correct elevation.
- B. Form and place cast-in-place concrete base pad, with provision for sanitary sewer pipe end sections.
- C. Level top surface of base pad; sleeve concrete shaft sections to receive storm sewer pipe sections.
- D. Establish elevations and pipe inverts for inlets and outlets as indicated.
- E. Mount lid and frame level in grout, secured to top cone section to elevation indicated.

3.04 FIELD QUALITY CONTROL

- A. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.

3.05 PROTECTION

- A. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress.

END OF SECTION