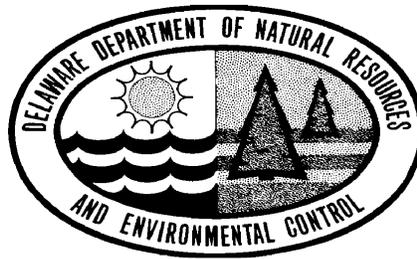


STATE OF DELAWARE

DEPARTMENT OF NATURAL RESOURCES
AND ENVIRONMENTAL CONTROL

DIVISION OF PARKS AND RECREATION



ASSAWOMAN CANAL TRAIL – PHASE 1

DNREC Contract #: 11-PS-02

Parks Project #: HL-10A

October 2014

ASSAWOMAN CANAL TRAIL – PHASE 1
DNREC Contract #: 11-PS-02

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**ASSAWOMAN CANAL TRAIL – PHASE 1
DNREC Contract #: 11-PS-02**

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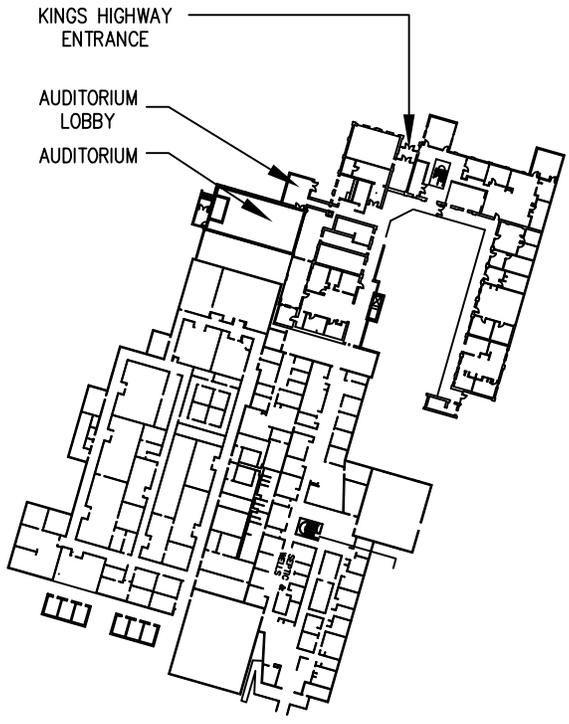
356001 – Helical Piles

Appendix A

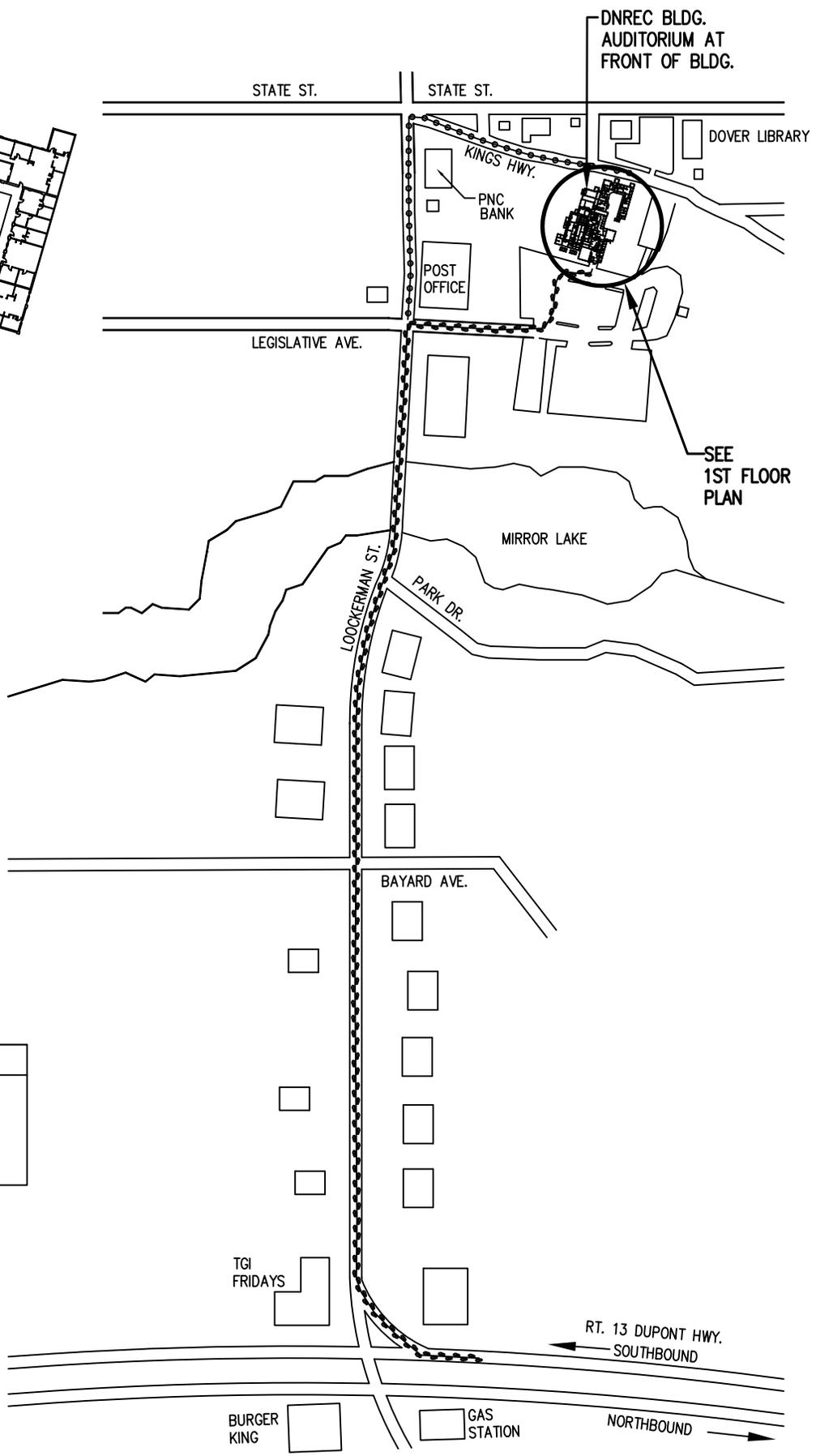
Geotechnical Report

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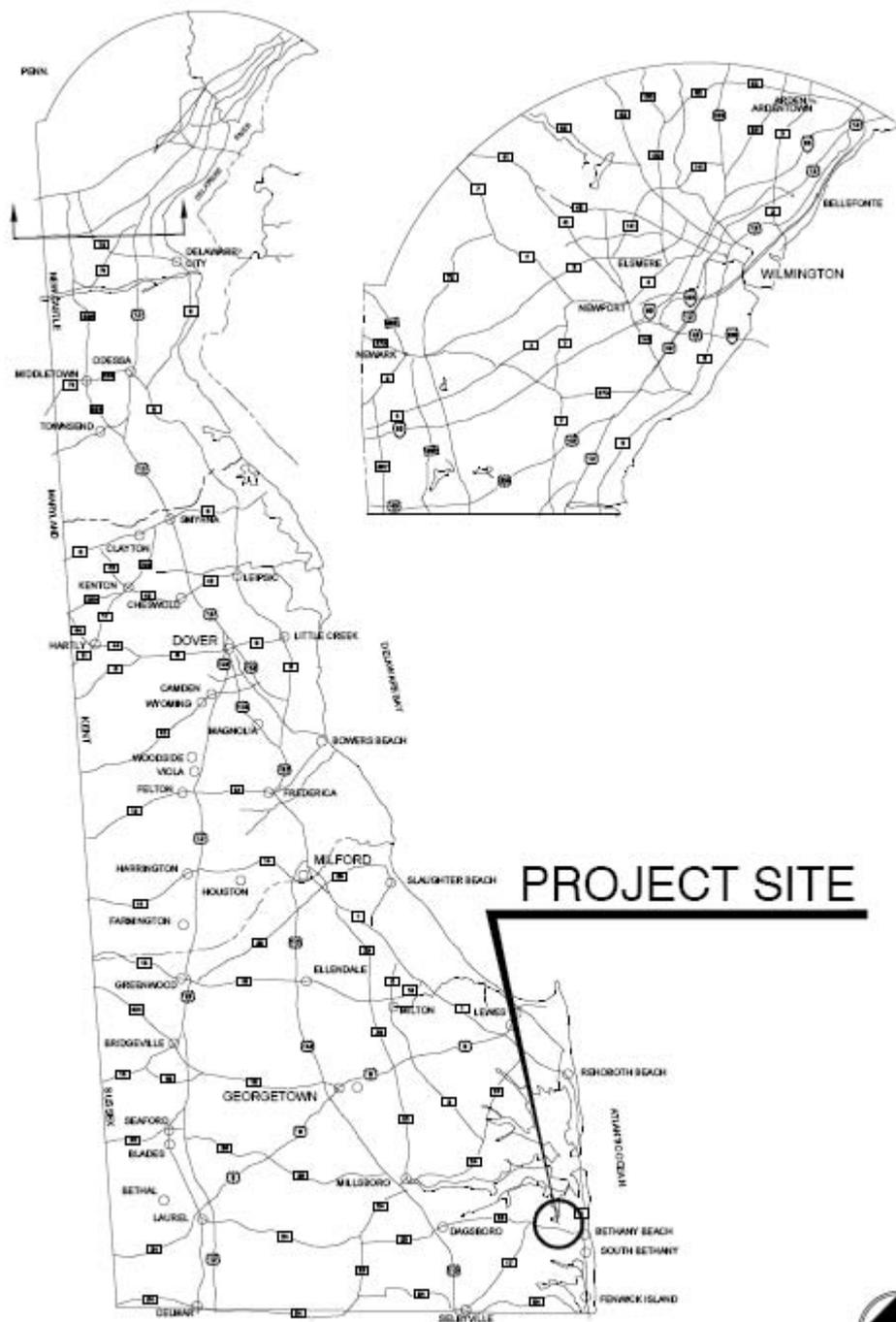
1ST FLOOR PLAN



LEGEND	
	ROUTE TO DNREC PARKING LOT FROM RT. 13 DUPONT HWY.
	ALTERNATE ROUTE TO STREET PARKING (2 HOUR LIMIT)

DNREC BUILDING (RICHARDSON & ROBBINS BUILDING) LOCATION MAP

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STATE OF DELAWARE



LOCATION MAP

NOT TO SCALE

Bid Opening Date: 11/24/2014

SECTION 00010 - INVITATION TO BID

The Department of Natural Resources and Environmental Control, Division of Parks and Recreation, Office of Design and Development, will receive sealed bids in the Auditorium, DNREC Building, 89 Kings Highway, Dover, Delaware 19901, until 3:30 p.m., November 24, 2014 at which time they will be publicly opened for the following project: Assawoman Canal Trail – Phase 1

This project includes construction of approximately 5,100 linear feet of 8' wide stone shared use path, pedestrian bridge, trailhead with 10 space permeable parking lot and restroom, miscellaneous site amenities and associated work.

A mandatory pre-bid meeting will be held at 10:00 a.m. November 6, 2014 at the project trailhead, 5 Town Road, Ocean View, DE. Attendance at this meeting is mandatory for all prospective bidders and will be a pre-requisite for submitting a bid.

Proposals shall be placed in a sealed envelope clearly marked BID ENCLOSED, Contract No. *11-PS-02* and addressed to:

Dept. of Natural Resources & Environmental Control
Division of Parks and Recreation
Office of Design and Development
89 Kings Highway Dover, De 19901
Attn: Cindy Todd Phone No. 302-739-9231

Prospective bidders may obtain bidding documents, digital copies on compact disc, upon payment of \$25.00 at the above address. Checks are to be made payable to the Division of Parks and Recreation. This payment is non-refundable and the documents need not be returned.

Each bid must be accompanied by a bid guarantee equivalent to ten percent (10%) of the amount of the base bid and all add alternates. The bid guarantee may be a certified check or a bid bond secured by a surety authorized to do business in Delaware. The bid guarantee shall be made payable to the Department of Natural Resources and Environmental Control.

A copy of the bidding documents can be reviewed at the Delaware Contractors Association, 527 Stanton Christiana Road, Newark, Delaware 19713.

The Department of Natural Resources and Environmental Control, Division of Parks and Recreation, Office of Design and Development reserves the right to waive irregularities and reject any or all bids, and to waive any informalities therein. The Department also reserves the right to extend the time and place for bid opening from that described in this advertisement, with not less than 2 calendar days notice by certified mail, facsimile transmission or other verifiable electronic means to those bidders who have obtained copies of the plans and specifications. An Equal Opportunity Employer.

David Small, Secretary

END OF SECTION 00010 - INVITATION TO BID

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SECTION 00100 - INSTRUCTIONS TO BIDDERS**TABLE OF ARTICLES**

1. GENERAL
2. BIDDER'S REPRESENTATIONS
3. BIDDING DOCUMENTS
4. BIDDING PROCEDURES
5. CONSIDERATION OF BIDS
6. POST-BID INFORMATION
7. PERFORMANCE BOND AND PAYMENT BOND
8. FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR

ARTICLE 1: GENERAL

1.1 DEFINITIONS

- 1.1.1 Whenever the following terms are used, their intent and meaning shall be interpreted as follows:

1.2 STATE: The State of Delaware.

1.3 AGENCY (OWNER): Contracting State Agency as noted on cover sheet.

1.4 DESIGNATED OFFICIAL: The agent authorized to act for the Agency.

1.5 BIDDING DOCUMENTS: Bidding Documents include the Bidding Requirements and the proposed Contract Documents. The Bidding Requirements consist of the Advertisement for Bid, Invitation to Bid, Instructions to Bidders, Supplementary Instructions to Bidders (if any), General Conditions, Supplementary General Conditions, General Requirements, Special Provisions (if any), the Bid Form (including the Non-collusion Statement), and other sample bidding and contract forms. The proposed Contract Documents consist of the form of Agreement between the Owner and Contractor, as well as the Drawings, Specifications (Project Manual) and all Addenda issued prior to execution of the Contract.

1.6 CONTRACT DOCUMENTS: The Contract Documents consist of the Instructions to Bidders, Supplementary Instructions to Bidders (if any), General Conditions, Supplementary General Conditions, General Requirements, Special Provisions (if any), the form of agreement between the Owner and the Contractor, Drawings (if any), Specifications (Project Manual), and all Addenda.

1.7 AGREEMENT: The form of the Agreement shall be AIA Document A101, Standard Form of Agreement Between Owner and Contractor where the basis of payment is a STIPULATED SUM. In the case of conflict between the instructions contained therein and the General Requirements herein, these General Requirements shall prevail.

1.8 GENERAL REQUIREMENTS (or CONDITIONS): General Requirements (or conditions) are instructions pertaining to the Bidding Documents and to contracts in general. They contain, in summary, requirements of laws of the State; policies of the Agency and instructions to bidders.

1.9 SPECIAL PROVISIONS: Special Provisions are specific conditions or requirements peculiar to the bidding documents and to the contract under consideration and are supplemental to the General Requirements. Should the Special Provisions conflict with the General Requirements, the Special Provisions shall prevail.

- 1.10 ADDENDA: Written or graphic instruments issued by the Owner/Architect prior to the Bid opening which modify or interpret the Bidding Documents by additions, deletions, clarifications or corrections.
- 1.11 BIDDER OR VENDOR: A person or entity who formally submits a Bid for the material or Work contemplated, acting directly or through a duly authorized representative who meets the requirements set forth in the Bidding Documents.
- 1.12 SUB-BIDDER: A person or entity who submits a Bid to a Bidder for materials or labor, or both for a portion of the Work.
- 1.13 BID: A complete and properly executed proposal to do the Work for the sums stipulated therein, submitted in accordance with the Bidding Documents.
- 1.14 BASE BID: The sum stated in the Bid for which the Bidder offers to perform the Work described in the Bidding Documents as the base, to which Work may be added or from which Work may be deleted for sums stated in Alternate Bids (if any are required to be stated in the bid).
- 1.15 ALTERNATE BID (or ALTERNATE): An amount stated in the Bid, where applicable, to be added to or deducted from the amount of the Base Bid if the corresponding change in the Work, as described in the Bidding Documents, is accepted.
- 1.16 UNIT PRICE: An amount stated in the Bid, where applicable, as a price per unit of measurement for materials, equipment or services or a portion of the Work as described in the Bidding Documents.
- 1.17 SURETY: The corporate body which is bound with and for the Contract, or which is liable, and which engages to be responsible for the Contractor's payments of all debts pertaining to and for his acceptable performance of the Work for which he has contracted.
- 1.18 BIDDER'S DEPOSIT: The security designated in the Bid to be furnished by the Bidder as a guaranty of good faith to enter into a contract with the Agency if the Work to be performed or the material or equipment to be furnished is awarded to him.
- 1.19 CONTRACT: The written agreement covering the furnishing and delivery of material or work to be performed.
- 1.20 CONTRACTOR: Any individual, firm or corporation with whom a contract is made by the Agency.
- 1.21 SUBCONTRACTOR: An individual, partnership or corporation which has a direct contract with a contractor to furnish labor and materials at the job site, or to perform construction labor and furnish material in connection with such labor at the job site.
- 1.22 CONTRACT BOND: The approved form of security furnished by the Contractor and his surety as a guaranty of good faith on the part of the Contractor to execute the Work in accordance with the terms of the Contract.
- 1.23 PROJECT SCHEDULE: The project shall be substantially complete by May 8th, 2014 with final completion and contract close out by May 20, 2014.

1.24. SPECIFIC PROJECT REQUIREMENTS

- 1.24.1 **Bidders are required to inspect the project site** and ensure they account for all existing conditions in the preparation of Bids. The project bid form will require Bidders to attest to said inspection.
- 1.24.2 **Bidders are required to inspect all construction access points** and ensure all Bids account for the specific timing and directional use restrictions of said entrances in Bids.
- 1.24.3 Most of the trail construction occurs within a 16 liner foot wide area of disturbance. To accomplish this work, **Bidders must account for the procurement and use of appropriately sized equipment.** Equipment must be able to complete the work within identified limits of disturbance and without damaging adjacent property and vegetation.
- 1.24.4 The Owner has facilitated the temporary use of a parcel for construction material storage and trail access, off of Osprey Lane. The use of this parcel must follow requirements provided on the contract drawings and other contract documents. The site must be visually screened during use and returned to pre-existing condition following construction activities.
- 1.24.5 **Bidders must account for a rolling area of disturbance and construction. Specifically, areas disturbed must be stabilized, to the satisfaction of DNREC Sediment and Stormwater Staff, on a daily basis.** All trail construction disturbance shall be done in daily phases, disturbing area that will be constructed and stabilized on a daily basis. Failure to follow a daily disturb and stabilize construction method will require the installation of erosion control measures as required by DNREC Sediment and Stormwater requirements, along the whole project limit of disturbance boundary. This large additional cost shall be borne by the Contractor and completed at no expense to the Owner.
- 1.24.6 Contractor shall make every attempt to identify private utilities run from adjacent residential parcels, into the project area. Upon discovery, Contractor shall notify Owner. Owner shall coordinate communication with adjacent landowners and direct Contractor in removal and abandonment of said utilities within project limit of disturbance.
- 1.24.7 Working Hours: Allowable working hours shall be from 7:00 a.m. to 7:00 p.m., Monday through Friday.

ARTICLE 2: BIDDER'S REPRESENTATIONS

2.1 PRE-BID MEETING

- 2.1.1 A Pre-bid Meeting for this Project will be held at the time and place designated. **Attendance at this meeting is a pre-requisite for submitting a Bid.**

2.2 By submitting a Bid, the Bidder represents that:

- 2.2.1 The Bidder has read and understands the Bidding Documents and that the Bid is made in accordance therewith.
- 2.2.2 The Bidder has visited the site, become familiar with existing conditions under which the Work is to be performed, and has correlated the Bidder's personal observations with the requirements of the proposed Contract Documents.

2.2.3 The Bid is based upon the materials, equipment, and systems required by the Bidding Documents without exception.

2.3 JOINT VENTURE REQUIREMENTS

2.3.1 For Public Works Contracts, each Joint Venturer shall be qualified and capable to complete the Work with their own forces.

2.3.2 Included with the Bid submission, and as a requirement to bid, a copy of the executed Joint Venture Agreement shall be submitted and signed by all Joint Venturers involved.

2.3.3 All required Bid Bonds, Performance Bonds, Material and Labor Payment Bonds must be executed by both Joint Venturers and be placed in both of their names.

2.3.4 All required insurance certificates shall name both Joint Venturers.

2.3.5 Both Joint Venturers shall sign the Bid Form and shall submit a copy of a valid Delaware Business License with their Bid.

2.3.6 Both Joint Venturers shall include their Federal E.I. Number with the Bid.

2.3.7 In the event of a mandatory Pre-bid Meeting, each Joint Venturer shall have a representative in attendance.

2.3.8 Due to exceptional circumstances and for good cause shown, one or more of these provisions may be waived at the discretion of the State.

2.4 ASSIGNMENT OF ANTITRUST CLAIMS

2.4.1 As consideration for the award and execution by the Owner of this Contract, the Contractor hereby grants, conveys, sells, assigns and transfers to the State of Delaware all of its right, title and interests in and to all known or unknown causes of action it presently has or may now or hereafter acquire under the antitrust laws of the United States and the State of Delaware, relating to the particular goods or services purchased or acquired by the Owner pursuant to this Contract.

ARTICLE 3: BIDDING DOCUMENTS

3.1 COPIES OF BID DOCUMENTS

3.1.1 Prospective Bidders may obtain complete sets of the Bidding Documents at the Department of Natural Resources & Environmental Control, Division of Parks & Recreation, Office of Design and Development, 89 Kings Highway, Dover, Delaware 19901. The cost for these documents is listed in the Invitation to Bid. This payment is non-refundable and the documents need not be returned.

3.1.2 Bidders shall use complete sets of Bidding Documents for preparation of Bids. Neither the issuing Agency nor the Architect assumes responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

3.1.3 Any errors, inconsistencies or omissions discovered shall be reported to the Architect immediately.

3.1.4 The Agency and Architect may make copies of the Bidding Documents available on the above terms for the purpose of obtaining Bids on the Work. No license or grant of use is conferred by issuance of copies of the Bidding Documents.

3.2 INTERPRETATION OR CORRECTION OF BIDDING DOCUMENTS

- 3.2.1 The Bidder shall carefully study and compare the Bidding Documents with each other, and with other work being bid concurrently or presently under construction to the extent that it relates to the Work for which the Bid is submitted, shall examine the site and local conditions, and shall report any errors, inconsistencies, or ambiguities discovered to the Architect.
- 3.2.2 Bidders or Sub-bidders requiring clarification or interpretation of the Bidding Documents shall make a written request to the Owner at least seven (7) days prior to the date for receipt of Bids. Interpretations, corrections and changes to the Bidding Documents will be made by written Addendum. Interpretations, corrections, or changes to the Bidding Documents made in any other manner shall not be binding.
- 3.2.3 The apparent silence of the Specifications as to any detail, or the apparent omission from it of detailed description concerning any point, shall be regarded as meaning that only the best commercial practice is to prevail and only material and workmanship of the first quality are to be used. Proof of Specification compliance will be the responsibility of the Bidder.
- 3.2.4 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for all permits, labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for the proper execution and completion of the Work.
- 3.2.5 The Owner will bear the costs for all impact and user fees associated with the Project.

3.3 SUBSTITUTIONS

- 3.3.1 The materials, products and equipment described in the Bidding Documents establish a standard of quality, required function, dimension, and appearance to be met by any proposed substitution. The specification of a particular manufacturer or model number is not intended to be proprietary in any way. Substitutions of products for those named will be considered, providing that the Vendor certifies that the function, quality, and performance characteristics of the material offered is equal or superior to that specified. It shall be the Bidder's responsibility to assure that the proposed substitution will not affect the intent of the design, and to make any installation modifications required to accommodate the substitution.
- 3.3.2 Requests for substitutions shall be made in writing to, and received by, the Owner before 4:30 p.m., at least ten (10) days prior to the date of the Bid Opening. Such requests shall include a complete description of the proposed substitution, drawings, performance and test data, explanation of required installation modifications due to the substitution, and any other information necessary for an evaluation. (Refer to Section 01600 for additional requirements) The burden of proof of the merit of the proposed substitution is upon the proposer. The Architect's decision of approval or disapproval shall be final. The Architect is to notify Owner prior to any approvals.
- 3.3.3 If the Architect approves a substitution prior to the receipt of Bids, such approval shall be set forth in an Addendum. Approvals made in any other manner shall not be binding.
- 3.3.4 The Architect shall have no obligation to consider any substitutions after the time specified in 3.3.2 of this Section.

3.4 ADDENDA

- 3.4.1 Addenda will be sent by mail, fax, or other verifiable electronic means to all who are known by the Architect to have received a complete set of the Bidding Documents.
- 3.4.2 Copies of Addenda will be made available for inspection wherever Bidding Documents are on file for that purpose.
- 3.4.3 No Addenda will be issued later than 4 days prior to the date for receipt of Bids except an Addendum withdrawing the request for Bids or one which extends the time or changes the location for the opening of Bids.
- 3.4.4 Each Bidder shall ascertain prior to submitting his Bid that they have received all Addenda issued, and shall acknowledge their receipt in their Bid in the appropriate space. Not acknowledging issued Addenda could be grounds for determining a bid to be non-responsive.

ARTICLE 4: BIDDING PROCEDURES

4.1 PREPARATION OF BIDS

- 4.1.1 Submit the bids on the Bid Forms included with the Bidding Documents.
- 4.1.2 Submit the original Bid Form for each bid. Bid Forms may be removed from the Project Manual for this purpose.
- 4.1.3 Execute all blanks on the Bid Form in a non-erasable medium (typewriter or manually in ink).
- 4.1.4 Where so indicated by the makeup of the Bid Form, express sums in both words and figures; in case of discrepancy between the two, the written amount shall govern.
- 4.1.5 Interlineations, alterations or erasures must be initialed by the signer of the Bid.
- 4.1.6 BID ALL REQUESTED ALTERNATES AND UNIT PRICES, IF ANY. If there is no change in the Base Bid for an Alternate, enter "No Change". The Contractor is responsible for verifying that they have received all Addenda issued during the bidding period. Work required by Addenda shall automatically become part of the Contract Documents.
- 4.1.7 Make no additional stipulations on the Bid Form and do not qualify the Bid in any other manner.
- 4.1.8 Each copy of the Bid shall include the legal name of the Bidder and a statement as to whether the Bidder is a sole proprietor, a partnership, a corporation, or any legal entity, and each copy shall be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid by a corporation shall further give the state of incorporation and have the corporate seal affixed. A Bid submitted by an agent shall have a current Power of Attorney attached, certifying agent's authority to bind the Bidder.
- 4.1.9 Bidder shall complete the Non-Collusion Statement form included with the Bid Forms and include it with their Bid.
- 4.1.10 In the construction of all Public Works Projects for the State of Delaware or any agency thereof, preference in employment of laborers, workers or mechanics shall be given to

bona fide legal citizens of the State who have established citizenship by residence of at least 90 days in the State.

4.1.11 Each Bidder shall include in their bid a copy of a valid Delaware Business License.

4.2 BID SECURITY

4.2.1 All bids shall be accompanied by a deposit of either a good and sufficient bond to the Agency for the benefit of the Agency, with corporate surety authorized to do business in this State, the form of the bond and the surety to be approved by the Agency, or a security of the bidder assigned to the Agency, for a sum equal to at least 10% of the bid plus all add alternates, or in lieu of the bid bond a security deposit in the form of a certified check, bank treasurer's check, cashier's check, money order, or other prior approved secured deposit assigned to the State. The bid bond need not be for a specific sum, but may be stated to be for a sum equal to 10% of the bid plus all add alternates to which it relates and not to exceed a certain stated sum, if said sum is equal to at least 10% of the bid. The Bid Bond form used shall be the standard Office of Management and Budget (OMB) form (attached).

4.2.2 The Agency has the right to retain the bid security of Bidders to whom an award is being considered until either a formal contract has been executed and bonds have been furnished or the specified time has elapsed so the Bids may be withdrawn or all Bids have been rejected.

4.2.3 In the event of any successful Bidder refusing or neglecting to execute a formal contract and bond within 20 days of the awarding of the contract, the bid bond or security deposited by the successful bidder shall be forfeited.

4.3 SUBCONTRACTOR LIST

4.3.1 As required by Delaware Code, Title 29, section 6962(d)(10)b, each Bidder shall submit with their Bid a completed List of Sub-Contractors included with the Bid Form. NAME ONLY ONE SUBCONTRACTOR FOR EACH TRADE. The List of Sub-Contractor categories, established at, or subsequent to, the Pre-Bid Meeting, will be issued by the Owner and mailed to all prospective bidders who have obtained bidding documents. A Bid will be considered non-responsive unless the completed list is included.

4.3.2 Provide the Name and Address for each listed Subcontractor. Addresses by City, Town or Locality, plus State, will be acceptable.

4.3.3 It is the responsibility of the Contractor to ensure that their Subcontractors are in compliance with the provisions of this law. Also, if a Contractor elects to list themselves as a Subcontractor for any category, they must specifically name themselves on the Bid Form and be able to document their capability to act as Subcontractor in that category in accordance with this law.

4.4 EQUALITY OF EMPLOYMENT OPPORTUNITY ON PUBLIC WORKS

4.4.1 During the performance of this Contract, the Contractor agrees as follows:

.1 The Contractor will not discriminate against any employee or applicant for employment because of race, creed, color, sex or national origin. The Contractor will take affirmative action to ensure the applicants are employed, and that employees are treated during employment, without regard to their race, creed, color, sex or national origin. Such action shall include, but not be limited to, the

following: Employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the contracting agency setting forth this nondiscrimination clause.

- .2 The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that "all qualified applicants will receive consideration for employment without regard to race, creed, color, sex or national origin."

4.5 PREVAILING WAGE REQUIREMENT

- 4.5.1 Wage Provisions: In accordance with Delaware Code, Title 29, Section 6960, renovation projects whose total cost shall exceed \$15,000, and \$100,000 for new construction, the minimum wage rates for various classes of laborers and mechanics shall be as determined by the Department of Labor, Division of Industrial Affairs of the State of Delaware.
- 4.5.2 The prevailing wage shall be the wage paid to a majority of employees performing similar work as reported in the Department's annual prevailing wage survey or in the absence of a majority, the average paid to all employees reported.
- 4.5.3 The employer shall pay all mechanics and labors employed directly upon the site of work, unconditionally and not less often than once a week and without subsequent deduction or rebate on any account, the full amounts accrued at time of payment, computed at wage rates not less than those stated in the specifications, regardless of any contractual relationship which may be alleged to exist between the employer and such laborers and mechanics.
- 4.5.4 The scale of the wages to be paid shall be posted by the employer in a prominent and easily accessible place at the site of the work.
- 4.5.5 Every contract based upon these specifications shall contain a stipulation that sworn payroll information, as required by the Department of Labor, be furnished weekly. The Department of Labor shall keep and maintain the sworn payroll information for a period of 6 months from the last day of the work week covered by the payroll.

4.6 SUBMISSION OF BIDS

- 4.6.1 Enclose the Bid, the Bid Security, and any other documents required to be submitted with the Bid in a sealed opaque envelope. Address the envelope to the party receiving the Bids. Identify with the project name, contract number, bid opening date and time, and the Bidder's name and address. If the Bid is sent by mail, enclose the sealed envelope in a separate mailing envelope with the notation "BID ENCLOSED" on the face thereof. The State is not responsible for the opening of bids prior to bid opening date and time that are not properly marked.
- 4.6.2 Deposit Bids at the designated location prior to the time and date for receipt of bids indicated in the Advertisement for Bids. Bids received after the time and date for receipt of bids will be marked "LATE BID" and returned.
- 4.6.3 Bidder assumes full responsibility for timely delivery at location designated for receipt of bids.

- 4.6.4 Oral, telephonic or telegraphic Bids are invalid and will not receive consideration.
- 4.6.5 Withdrawn Bids may be resubmitted up to the date and time designated for the receipt of Bids, provided that they are then fully in compliance with these Instructions to Bidders.

4.7 MODIFICATION OR WITHDRAW OF BIDS

- 4.7.1 Prior to the closing date for receipt of Bids, a Bidder may withdraw a Bid by personal request and by showing proper identification to the Architect. A request for withdraw by letter or fax, if the Architect is notified in writing prior to receipt of fax, is acceptable. A fax directing a modification in the bid price will render the Bid informal, causing it to be ineligible for consideration of award. Telephone directives for modification of the bid price shall not be permitted and will have no bearing on the submitted proposal in any manner.
- 4.7.2 Bidders submitting Bids that are late shall be notified as soon as practicable and the bid shall be returned.
- 4.7.3 A Bid may not be modified, withdrawn or canceled by the Bidder during a thirty (30) day period following the time and date designated for the receipt and opening of Bids, and Bidder so agrees in submitting their Bid. Bids shall be binding for 30 days after the date of the Bid opening.

ARTICLE 5: CONSIDERATION OF BIDS

5.1 OPENING/REJECTION OF BIDS

- 5.1.1 Unless otherwise stated, Bids received on time will be publicly opened and will be read aloud. An abstract of the Bids will be made available to Bidders.
- 5.1.2 The Agency shall have the right to reject any and all Bids. A Bid not accompanied by a required Bid Security or by other data required by the Bidding Documents, or a Bid which is in any way incomplete or irregular is subject to rejection.
- 5.1.3 If the Bids are rejected, it will be done within thirty (30) calendar days of the Bid opening.

5.2 COMPARISON OF BIDS

- 5.2.1 After the Bids have been opened and read, the bid prices will be compared and the result of such comparisons will be made available to the public. Comparisons of the Bids may be based on the Base Bid plus desired Alternates. The Agency shall have the right to accept Alternates in any order or combination.
- 5.2.2 The Agency reserves the right to waive technicalities, to reject any or all Bids, or any portion thereof, to advertise for new Bids, to proceed to do the Work otherwise, or to abandon the Work, if in the judgment of the Agency or its agent(s), it is in the best interest of the State.
- 5.2.3 An increase or decrease in the quantity for any item is not sufficient grounds for an increase or decrease in the Unit Price.
- 5.2.4 The prices quoted are to be those for which the material will be furnished F.O.B. Job Site and include all charges that may be imposed during the period of the Contract.

- 5.2.5 No qualifying letter or statements in or attached to the Bid, or separate discounts will be considered in determining the low Bid except as may be otherwise herein noted. Cash or separate discounts should be computed and incorporated into Unit Bid Price(s).

5.3 DISQUALIFICATION OF BIDDERS

- 5.3.1 An agency shall determine that each Bidder on any Public Works Contract is responsible before awarding the Contract. Factors to be considered in determining the responsibility of a Bidder include:

- .1 The Bidder's financial, physical, personnel or other resources including Subcontracts;
- .2 The Bidder's record of performance on past public or private construction projects, including, but not limited to, defaults and/or final adjudication or admission of violations of the Prevailing Wage Laws in Delaware or any other state;
- .3 The Bidder's written safety plan;
- .4 Whether the Bidder is qualified legally to contract with the State;
- .5 Whether the Bidder supplied all necessary information concerning its responsibility; and,
- .6 Any other specific criteria for a particular procurement, which an agency may establish; provided however, that, the criteria be set forth in the invitation to bid and is otherwise in conformity with State and/or Federal law.

- 5.3.2 If an agency determines that a Bidder is nonresponsive and/or nonresponsible, the determination shall be in writing and set forth the basis for the determination. A copy of the determination shall be sent to the affected Bidder within five (5) working days of said determination.

- 5.3.3 In addition, any one or more of the following causes may be considered as sufficient for the disqualification of a Bidder and the rejection of their Bid or Bids.

- .1 More than one Bid for the same Contract from an individual, firm or corporation under the same or different names.
- .2 Evidence of collusion among Bidders.
- .3 Unsatisfactory performance record as evidenced by past experience.
- .4 If the Unit Prices are obviously unbalanced either in excess or below reasonable cost analysis values.
- .5 If there are any unauthorized additions, interlineation, conditional or alternate bids or irregularities of any kind which may tend to make the Bid incomplete, indefinite or ambiguous as to its meaning.
- .6 If the Bid is not accompanied by the required Bid Security and other data required by the Bidding Documents.
- .7 If any exceptions or qualifications of the Bid are noted on the Bid Form.

5.4 ACCEPTANCE OF BID AND AWARD OF CONTRACT

- 5.4.1 A formal Contract shall be executed with the successful Bidder within twenty (20) calendar days after the award of the Contract.
- 5.4.2 Per Section 6962(d)(13) a., Title 29, Delaware Code, The contracting agency shall award any Public Works Contract within thirty (30) days of the bid opening to the lowest responsive and responsible Bidder, provided the amount of the low bid does not exceed the amount of funds available to the Owner to finance the contract, unless the Agency elects to award on the basis of best value, in which case the election to award on the basis of best value shall be stated in the invitation to bid.
- 5.4.3 Each Bid on any Public Works Contract must be deemed responsive by the Agency to be considered for award. A responsive Bid shall conform in all material respects to the requirements and criteria set forth in the Contract Documents and specifications.
- 5.4.4 The Agency shall have the right to accept Alternates in any order or combination, and to determine the low Bidder on the basis of the sum of the Base Bid, plus accepted Alternates.
- 5.4.5 The successful Bidder shall execute a formal Contract, submit the required Insurance Certificate, and furnish good and sufficient Bonds, unless specifically waived in the General Requirements, in accordance with the General Requirement, within twenty (20) days of official notice of contract award. Bonds shall be for the benefit of the Agency with surety in the amount of 100% of the total contract award. Said Bonds shall be conditioned upon the faithful performance of the Contract. Bonds shall remain in effect for a period of two years after the date of Substantial Completion.
- 5.4.6 If the successful Bidder fails to execute the required Contract and Bond, as aforesaid, within twenty (20) calendar days after the date of official Notice of the Award of the Contract, their Bid Guaranty shall immediately be taken and become the property of the State for the benefit of the Agency as liquidated damages, and not as a forfeiture or as a penalty. Award will then be made to the next lowest qualified Bidder of the Work or readvertised, as the Agency may decide.
- 5.4.7 Each bidder shall supply with its bid its taxpayer identification number (i.e., federal employer identification number or social security number) and a copy of its Delaware business license, and should the vendor be awarded a contract, such vendor shall provide to the agency the taxpayer identification license numbers of such subcontractors. Such numbers shall be provided on the later of the date on which such subcontractor is required to be identified or the time the contract is executed. The successful Bidder shall provide to the agency to which it is contracting, within 30 days of entering into such public works contract, copies of all Delaware Business licenses of subcontractors and/or independent contractors that will perform work for such public works contract. However, if a subcontractor or independent contractor is hired or contracted more than 20 days after the Bidder entered the public works contract the Delaware Business license of such subcontractor or independent contractor shall be provided to the agency within 10 days of being contracted or hired.
- 5.4.8 The Bid Security shall be returned to the successful Bidder upon the execution of the formal contract. The Bid Securities of unsuccessful bidders shall be returned within thirty (30) calendar days after the opening of the Bids.

ARTICLE 6: POST-BID INFORMATION

6.1 CONTRACTOR'S QUALIFICATION STATEMENT

- 6.1.1 Bidders to whom award of a Contract is under consideration shall, if requested by the Agency, submit a properly executed AIA Document A305, Contractor's Qualification Statement, unless such a statement has been previously required and submitted.

6.2 BUSINESS DESIGNATION FORM

- 6.2.1 Successful Bidder shall be required to accurately complete an Office of Management and Budget Business Designation Form for Subcontractors.

ARTICLE 7: PERFORMANCE BOND AND PAYMENT BOND

7.1 BOND REQUIREMENTS

- 7.1.1 The cost of furnishing the required Bonds, that are stipulated in the Bidding Documents, shall be included in the Bid.
- 7.1.2 If the Bidder is required by the Agency to secure a Bond from other than the Bidder's usual sources, changes in cost will be adjusted as provided in the Contract Documents.
- 7.1.3 The Performance and Payment Bond forms used shall be the standard Office of Management and Budget (OMB) forms (attached).

7.2 TIME OF DELIVERY AND FORM OF BONDS

- 7.2.1 The Bonds shall be dated on or after the date of the Contract.
- 7.2.2 The Bidder shall require the attorney-in-fact who executes the required Bonds on behalf of the surety to affix a certified and current copy of the power of attorney.

ARTICLE 8: FORM OF AGREEMENT BETWEEN OWNER (AGENCY) AND CONTRACTOR

- 8.1 Unless otherwise required in the Bidding Documents, the Agreement for the Work will be written on AIA Document A101, Standard Form of Agreement Between Owner and Contractor Where the Basis of Payment is a Stipulated Sum.

END OF SECTION 00100 - INSTRUCTIONS TO BIDDERS

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ASSAWOMAN CANAL TRAIL – PHASE 1
DNREC Contract #: 11-PS-02

BID FORM

For Bids Due: November 24, 2014

To: Dept. of Natural Resources & Environmental Control
Division of Parks & Recreation
Office of Design and Development
89 Kings Highway Dover, DE 19901

Name of Bidder: _____

Delaware Business License No.: _____
(A copy of a Bidders Delaware Business License must be attached to this form.)

Employers Identification No.: _____

Phone No.: (_____) _____ - _____ Fax No.: (_____) _____

The undersigned, representing that he has read and understands the Bidding Documents and that this bid is made in accordance therewith, that he has visited the site and has familiarized himself with the local conditions under which the Work is to be performed, that he has familiarized himself with all conditions affecting the prosecution of the work including the availability of materials and labor, and that his bid is based upon the materials, systems and equipment described in the Bidding Documents without exception, hereby proposes and agrees to provide all labor, materials, plant, equipment, supplies, transport and other facilities required to execute the work described by the aforesaid documents for the lump sum itemized below:

UNIT PRICES

Unit prices conform to applicable project specification sections. Refer to Specification Section 01026 - Unit Prices for a complete description of the following Unit Prices:

Item #	Bid Item Description	Unit	Quantity	Cost	Total Price
1	Mobilization/Demobilization	LS	1.00	_____	
2	Erosion & Sediment Control	LS	1.00	_____	
3	Field Engineering	LS	1.00	_____	

ASSAWOMAN CANAL TRAIL – PHASE 1
DNREC Contract #: 11-PS-02

BID FORM

Item #	Bid Item Description	Unit	Quantity	Cost	Total Price
4	Clearing & Grubbing & Removal of Obstructions	LS	1.00	_____	
5	Bulk Grading	LS	1.00	_____	
6	Final Grade, Topsoil Seed, Stabilize & Restore	LS	1.00	_____	
7	Offsite Disposal of All Excess Fill / Topsoil	LS	1.00	_____	
8	8' Wide Stone Dust Trail	SY	4,588	_____	
9	Pedestrian Bridge	LS	1.00	_____	
10	Helical Pile (Plumb)	LF	240	_____	
11	Helical Pile (Batter)	LF	96	_____	
12	Concrete Sidewalks & Plaza	LS	1	_____	
13	Trailhead Civil Site Work	LS	1.00	_____	
	Includes Entrance, Parking Lot, and Utilities				
14	Restroom Building (Pre-fabricated)	LS	1.00	_____	
	Includes Pre-fabricated Restroom with Options, and Utility Connections.				

ASSAWOMAN CANAL TRAIL – PHASE 1
DNREC Contract #: 11-PS-02

BID FORM

15	Phase 1 Appurtenances and Misc.	LS	1.00	_____	
Includes but not limited to Bicycle Racks, Bollards, Trail signage, Benches and Iron Ranger Fee Collection Station.					
16	Trailhead Landscaping	LS	1.00	_____	
17	Signage and Striping	LS	1.00	_____	
All Road and Pedestrian Signage, Striping & Misc. Markings					

UNIT PRICE TOTAL

\$ _____
(Total In Numbers)

\$ _____
(Total In Words)

NOT FOR BIDDING

ASSAWOMAN CANAL TRAIL – PHASE 1
DNREC Contract #: 11-PS-02

BID FORM

CONTINGENT UNIT PRICE BID ITEMS

Item #	Bid Item Description	Unit	Quantity	Cost	Total Price
18	Visual Buffer Plantings (Shade)	LF	250.00	-----	
19	Visual Buffer Plantings (Sun)	LF	250.00	-----	
20	Additional Tree Removal (≤ 12 inch caliper)	EA	10.00	-----	
21	Additional Tree Removal (≥ 12 inch caliper)	EA	10.00	-----	

CONTINGENT UNIT PRICE TOTAL

\$

(Total In Numbers)

\$

(Total In Words)

PROJECT GRAND TOTAL

\$

(Total In Numbers)

\$

(Total In Words)

ASSAWOMAN CANAL TRAIL – PHASE 1
DNREC Contract #: 11-PS-02

BID FORM

I/We acknowledge Addendums numbered _____ and the price(s) include any cost/schedule impact they may have.

I/We acknowledge _____(initial) completing a site visit that included review of all existing conditions including vegetation and construction entrance locations and constraints.

I/We acknowledge _____(initial) completing a site visit and thorough review of all construction document information and that we have appropriate equipment to work within identified limits of disturbance and in compliance with the Contract Documents.

I/We agree that any changes in the scope of the work extra to the Contract requirements will be paid for pursuant to AIA Document A201, Article 7.

The bid shall remain valid and cannot be withdrawn for a period of thirty (30) days from the date of opening of bids, and the undersigned shall abide by the Bid Security forfeiture provisions. Bid Security is attached to this Bid.

The Owner shall have the right to reject any or all bids, and to waive any informality or irregularity in any bid received.

This bid is based upon work being accomplished by the Sub-Contractors named on the list attached to this bid.

Should I/We be awarded this contract, I/We pledge to achieve substantial completion of all the work of the Contract in accordance with the Construction Schedule and/or completion dates included with the Bid.

The undersigned represents and warrants that he has complied and shall comply with all requirements of local, state, and national laws; that no legal requirement has been or shall be violated in making or accepting this bid, in awarding the contract to him or in the prosecution of the work required; that the bid is legal and firm: that he has not, directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken action in restraint of free competitive bidding.

I/We agree that all applicable Federal, State, and local taxes and cost of required insurance are included in the proposed prices.

Upon receipt of written notice of the acceptance of this Bid, the Bidder shall, within twenty (20) calendar days, execute the agreement in the required form and deliver the Contract Bonds, and Insurance Certificates, required by the Contract Documents. This Proposal shall be attached as Exhibit A and made part of the Agreement executed by the Bidder.

I/We are licensed, or have initiated the license application as required by Section 2502, Chapter 25, Title 30, of the Delaware Code.

ASSAWOMAN CANAL TRAIL – PHASE 1
DNREC Contract #: 11-PS-02

BID FORM

I am / We are (Check one):

_____ **An Individual.**

_____ **A Partnership** duly recorded in the Prothonary's Office in _____ County pursuant to Title 6 Delaware Code, Chapter 31.

_____ **A Corporation** registered with the State of Delaware pursuant to Title 8 Delaware Code.

By _____
(Individual's / General Partner's / Corporate Name)

Trading as _____

State of Corporation _____

Business Address: _____

Witness: _____ **By:** _____
(Authorized Signature)

(CORPORATE SEAL, if applicable) _____
Typed or printed name

(Title)

Date: _____

ASSAWOMAN CANAL TRAIL – PHASE 1
DNREC Contract #: 11-PS-02

BID FORM

STATE OF _____)

_____ COUNTY) ss,

I hereby certify that before me this _____ day of _____,
20 _____, personally appeared _____, in
his official capacity as President/Principal, and acknowledged the aforesaid before me.

Given under by hand and notarial seal.

Notary Public

ATTACHMENTS

- Non-Collusion Statement
- Sub-Contractor List
- Bid Security (certified check or bid bond issued on mandatory form)
- (Others as Required by Project Manual)

NOT FOR BIDDING

BID FORM

NON-COLLUSION STATEMENT

This is to certify that the undersigned bidder has neither directly nor indirectly, entered into any agreement, participated in any collusion or otherwise taken any action in restraint of free competitive bidding in connection with this proposal submitted this date to the Department of Natural Resources and Environmental Control, Division of Parks and Recreation.

All the terms and conditions of Contract No. _____ have been thoroughly examined and understood.

Name of Bidder: _____

**Authorized Representative
(Typed or Printed):** _____

**Authorized Representative
(Signature):** _____

Title: _____

Address of Bidder: _____

Phone Number: _____

Sworn to and Subscribed before me this _____ day of _____
20_____.

My Commission expires _____ . NOTARY PUBLIC _____ .

This Page Must Be Signed And Notarized For Your Bid To Be Considered.

ASSAWOMAN CANAL TRAIL – PHASE 1
DNREC Contract #: 11-PS-02

BID FORM

SUBCONTRACTOR LIST

In accordance with Title 29, Chapter 6962 (d)(10)b Delaware Code, the following sub-contractor listing must accompany the bid submittal. The name and address (City and State) of the sub-contractor must be listed for each category where the bidder intends to use a sub-contractor to perform that category of work. In order to provide full disclosure and acceptance of the bid by the Owner, it is required that bidders list themselves as being the sub-contractor for all categories where he/she is qualified and intends to perform such work.

The bid may be considered non-responsive if this form is incomplete.

Subcontractor Category

Subcontractor Information

(Address: City & State- no street address required)

1. _____	Name: _____
	Address: _____
2. _____	Name: _____
	Address: _____
3. _____	Name: _____
	Address: _____
4. _____	Name: _____
	Address: _____
5. _____	Name: _____
	Address: _____

AGREEMENT FORM A101-2007

The following supplements modify the “Standard Form of Agreement Between Owner and Contractor,” AIA Document A101-2007. Where a portion of the Standard Form of Agreement is modified or deleted by the following, the unaltered portions of the Standard Form of Agreement shall remain in effect.

ARTICLE 5: PAYMENTS

5.1 PROGRESS PAYMENTS

5.1.3 Delete paragraph 5.1.3 in its entirety and replace with the following:

“Provided that a valid Application for Payment is received by the Architect that meets all requirements of the Contract, payment shall be made by the Owner not later than 30 days after the Owner receives the valid Application for Payment.”

ARTICLE 6: DISPUTE RESOLUTION

6.2 BINDING DISPUTE RESOLUTION

Check “Other” – and add the following sentence:

"Any remedies available in law or in equity."

ARTICLE 8: MISCELLANEOUS PROVISIONS

8.2 Insert the following:

"Payments are due 30 days after receipt of a valid Application for Payment. After that 30 day period, interest may be charged at the rate of 1% per month not to exceed 12% per annum."

8.5 Delete paragraph 8.5 in its entirety and replace with the following:

“The Contractor’s representative shall not be changed without ten days written notice to the Owner.”

END OF SECTION 00500 - AGREEMENT FORM

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STATE OF DELAWARE
OFFICE OF MANAGEMENT AND BUDGET

PERFORMANCE BOND

Bond Number: _____

KNOW ALL PERSONS BY THESE PRESENTS, that we, _____, as principal ("**Principal**"), and _____, a _____ corporation, legally authorized to do business in the State of Delaware, as surety ("**Surety**"), are held and firmly bound unto the State of Delaware, Department of Natural Resources and Environmental Control, Division of Parks and Recreation ("**Owner**"), in the amount of _____ (\$_____), to be paid to **Owner**, for which payment well and truly to be made, we do bind ourselves, our and each and every of our heirs, executors, administrators, successors and assigns, jointly and severally, for and in the whole, firmly by these presents.

Sealed with our seals and dated this _____ day of _____, 20__.

NOW THE CONDITION OF THIS OBLIGATION IS SUCH, that if **Principal**, who has been awarded by **Owner** that certain contract known as Contract No. _____ dated the _____ day of _____, 20__ (the "Contract"), which Contract is incorporated herein by reference, shall well and truly provide and furnish all materials, appliances and tools and perform all the work required under and pursuant to the terms and conditions of the Contract and the Contract Documents (as defined in the Contract) or any changes or modifications thereto made as therein provided, shall make good and reimburse **Owner** sufficient funds to pay the costs of completing the Contract that **Owner** may sustain by reason of any failure or default on the part of **Principal**, and shall also indemnify and save harmless **Owner** from all costs, damages and expenses arising out of or by reason of the performance of the Contract and for as long as provided by the Contract; then this obligation shall be void, otherwise to be and remain in full force and effect.

Surety, for value received, hereby stipulates and agrees, if requested to do so by **Owner**, to fully perform and complete the work to be performed under the Contract pursuant to the terms, conditions and covenants thereof, if for any cause **Principal** fails or neglects to so fully perform and complete such work.

Surety, for value received, for itself and its successors and assigns, hereby stipulates and agrees that the obligation of **Surety** and its bond shall be in no way impaired or affected by any extension of time, modification, omission, addition or change in or to the Contract or the work to be performed thereunder, or by any payment thereunder before the time required therein, or by any waiver of any provisions thereof, or by any assignment, subletting or other transfer thereof or of any work to be performed or any monies due or to become due thereunder; and **Surety** hereby waives notice of any and all such extensions, modifications, omissions, additions, changes, payments, waivers, assignments, subcontracts and transfers and hereby expressly stipulates and agrees that any and all things done and omitted to be done by and in relation to assignees, subcontractors, and other transferees shall have the same effect as to **Surety** as though done or omitted to be done by or in relation to **Principal**.

Surety hereby stipulates and agrees that no modifications, omissions or additions in or to the terms of the Contract shall in any way whatsoever affect the obligation of **Surety** and its bond.

Any proceeding, legal or equitable, under this Bond may be brought in any court of competent jurisdiction in the State of Delaware. Notices to **Surety** or Contractor may be mailed or delivered to them at their respective addresses shown below.

IN WITNESS WHEREOF, **Principal** and **Surety** have hereunto set their hand and seals, and such of them as are corporations have caused their corporate seal to be hereto affixed and these presents to be signed by their duly authorized officers, the day and year first above written.

PRINCIPAL

Name: _____

Witness or Attest: Address: _____

Name:

(Corporate Seal)

By: _____(SEAL)
Name:
Title:

SURETY

Name: _____

Witness or Attest: Address: _____

Name:

(Corporate Seal)

By: _____(SEAL)
Name:
Title:

STATE OF DELAWARE
OFFICE OF MANAGEMENT AND BUDGET

PAYMENT BOND

Bond Number: _____

KNOW ALL PERSONS BY THESE PRESENTS, that we, _____, as principal ("**Principal**"), and _____, a _____ corporation, legally authorized to do business in the State of Delaware, as surety ("**Surety**"), are held and firmly bound unto the State of Delaware, Department of Natural Resources and Environmental Control, Division of Parks and Recreation ("**Owner**"), in the amount of _____ (\$_____), to be paid to **Owner**, for which payment well and truly to be made, we do bind ourselves, our and each and every of our heirs, executors, administrators, successors and assigns, jointly and severally, for and in the whole firmly by these presents.

Sealed with our seals and dated this _____ day of _____, 20__.

NOW THE CONDITION OF THIS OBLIGATION IS SUCH, that if **Principal**, who has been awarded by **Owner** that certain contract known as Contract No. _____ dated the _____ day of _____, 20__ (the "Contract"), which Contract is incorporated herein by reference, shall well and truly pay all and every person furnishing materials or performing labor or service in and about the performance of the work under the Contract, all and every sums of money due him, her, them or any of them, for all such materials, labor and service for which **Principal** is liable, shall make good and reimburse **Owner** sufficient funds to pay such costs in the completion of the Contract as **Owner** may sustain by reason of any failure or default on the part of **Principal**, and shall also indemnify and save harmless **Owner** from all costs, damages and expenses arising out of or by reason of the performance of the Contract and for as long as provided by the Contract; then this obligation shall be void, otherwise to be and remain in full force and effect.

Surety, for value received, for itself and its successors and assigns, hereby stipulates and agrees that the obligation of **Surety** and its bond shall be in no way impaired or affected by any extension of time, modification, omission, addition or change in or to the Contract or the work to be performed thereunder, or by any payment thereunder before the time required therein, or by any waiver of any provisions thereof, or by any assignment, subletting or other transfer thereof or of any work to be performed or any monies due or to become due thereunder; and **Surety** hereby waives notice of any and all such extensions, modifications, omissions, additions, changes, payments, waivers, assignments, subcontracts and transfers and hereby expressly stipulates and agrees that any and all things done and omitted to be done by and in relation to assignees, subcontractors, and other transferees shall have the same effect as to **Surety** as though done or omitted to be done by or in relation to **Principal**.

Surety hereby stipulates and agrees that no modifications, omission or additions in or to the terms of the Contract shall in any way whatsoever affect the obligation of **Surety** and its bond.

Any proceeding, legal or equitable, under this Bond may be brought in any court of competent jurisdiction in the State of Delaware. Notices to **Surety** or Contractor may be mailed or delivered to them at their respective addresses shown below.

IN WITNESS WHEREOF, **Principal** and **Surety** have hereunto set their hand and seals, and such of them as are corporations have caused their corporate seal to be hereto affixed and these presents to be signed by their duly authorized officers, the day and year first above written.

PRINCIPAL

Name: _____

Witness or Attest: Address: _____

Name:

(Corporate Seal)

By: _____(SEAL)

Name:
Title:

SURETY

Name: _____

Witness or Attest: Address: _____

Name:

(Corporate Seal)

By: _____(SEAL)

Name:
Title:

SECTION 00600 - BONDS, CERTIFICATES AND ADMINISTRATIVE FORMS**TABLE OF ARTICLES**

1. Related Work Specified Elsewhere
2. Forms Submitted By Contractor
3. Forms Prepared by Owner

ARTICLE 1: Related Work Specified Elsewhere:

Section 00100 Instructions to Bidders
Section 00300 Bid Form
Section 00500 Agreement Form
Section 00700 General Conditions
Section 00710 General Requirements
Section 00800 Supplementary General Conditions

ARTICLE 2: Forms Submitted By Contractor:

- 2.1 Reference is made throughout this Project Manual to a number of standard forms which the Contractor is required to submit to the Owner prior to and during the execution of Work of this Project.
- 2.2 The Contractor shall be responsible for obtaining and submitting the following forms to the Owner when the forms are completed as specified.
- 2.3 Prior to commencing work, submit forms:
 - .1 AIA Document G715 "Acord Certificate of Insurance" (Latest Edition).
 - .2 "Performance Bond" and "Payment Bond" (Samples enclosed) Use of these forms is mandatory.
- 2.4 During the execution of the work, as appropriate, and prior to final payment, submit forms:
 - .1 AIA Document G702 "Application and Certificate for Payment".
 - .2 AIA Document G703 "Continuation Sheet" for G702, "Application and Certificate for Payment".
 - .3 AIA Document G706 "Contractor's Affidavit of Payment of Debts and Claims" (Latest Edition).
 - .4 AIA Document G706A "Contractor's Affidavit of Release of Liens" (Latest Edition).
 - .5 AIA Document G707 "Consent of Surety to Final Payment" (Latest Edition).
 - .6 AIA Document G707A "Consent of Surety to Reduction in or Partial Release of Retainage" (Latest Edition).
 - .7 Payroll Report (Sample Enclosed).
 - .8 "Employing Delawareans Reporting Requirements for Awarded Contracts" (when required).

- 2.5 The forms specified above are available for examination in the Owner's office by prospective Bidders. Failure to examine the specified documents and to make allowances for them in his Bid, shall not relieve the Contractor from using the forms and complying with their requirements.

ARTICLE 3: Forms Prepared by Owner:

- 3.1 The Owner shall prepare the following standard forms, as appropriate:
- .1 AIA Document A101-2007 "Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum".
 - .2 AIA Document G701 "Change Order" (Latest Edition).
 - .3 AIA Document G704 "Certificate of Substantial Completion" (Latest Edition).
 - .4 AIA Document G714 "Construction Change Directive" (Latest Edition).

END OF SECTION 00600 – BONDS CERTIFICATES AND ADMINISTRATIVE FORMS

DATE _____

I, _____ (Name of signatory party) _____ (Title)

do hereby state:

1. That I pay or supervise the payment of persons employed by

_____, _____ on the _____

(Contractor or Subcontractor)

(public project)

that during the payroll period commencing on the _____ day of _____, 20_____ and ending on the _____ day of _____, 20_____ all persons employed on said project

_____ have been paid the full weekly wages earned, that no rebates have been or will be made either directly or indirectly to or on behalf of the contractor or subcontractor from the full weekly wages earned by any person and that no deductions have been made either directly or indirectly from the full wages earned by any person, other than permissible deductions as defined in the prevailing wage regulations of the State of Delaware.

2. That any payrolls otherwise under this contract required to be submitted for the above period are correct and complete; that the wage rates for laborers or mechanics contained therein are not less than applicable wage rates contained in any wage determination incorporated into the contract; that the classifications set forth therein for each laborer or mechanic conform with the work performed.

3. That any apprentices employed in the above period are duly registered in a bona fide apprenticeship program registered with a state apprenticeship agency recognized by the Bureau of Apprenticeship and Training, United States Department of Labor, and that the worksite ratio of apprentices to mechanics does not exceed the ratio permitted by the prevailing wage regulations of the State of Delaware.

An employer who fails to submit sworn payroll information to the Department of Labor weekly shall be subject to fines of \$1,000.00 and \$5,000.00 for each violation.

List only those fringe benefits:

For which the employer has paid; and
Which have been used to offset the full prevailing wage rate.

(See Delaware Prevailing Wage Regulations for explanation of how hourly value of benefits is to be computed.)

HOURLY COST OF BENEFITS	
(List in same order shown on front of record)	
Employee	
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	

I hereby certify that the foregoing information is true and correct to the best of my knowledge and belief. I realize that making a false statement under oath is a crime in State of Delaware

Signature _____

STATE OF _____

COUNTY OF _____

SWORN TO AND SUBSCRIBED BEFORE ME, A NOTARY PUBLIC,

THIS _____ DAY OF _____, A.D. 20_____

Notary Public

STATE OF DELAWARE
 DEPARTMENT OF LABOR
 DIVISION OF INDUSTRIAL AFFAIRS
 OFFICE OF LABOR LAW ENFORCEMENT
 PHONE: (302) 451-3423

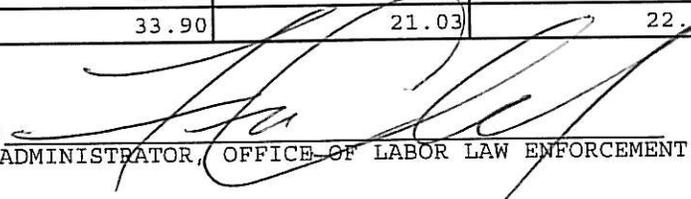
Mailing Address:
 225 CORPORATE BOULEVARD
 SUITE 104
 NEWARK, DE 19702

Located at:
 225 CORPORATE BOULEVARD
 SUITE 104
 NEWARK, DE 19702

PREVAILING WAGES FOR HIGHWAY CONSTRUCTION EFFECTIVE MARCH 14, 2014

CLASSIFICATION	NEW CASTLE	KENT	SUSSEX
BRICKLAYERS	48.08	48.08	14.51
CARPENTERS	43.15	50.91	40.47
CEMENT FINISHERS	30.88	26.13	26.33
ELECTRICAL LINE WORKERS	22.50	22.50	21.25
ELECTRICIANS	62.10	62.10	62.10
IRON WORKERS	42.20	23.87	25.35
LABORERS	33.01	38.68	37.97
MILLWRIGHTS	16.11	15.63	13.49
PAINTERS	60.64	60.64	60.64
PILEDRIVERS	66.42	23.75	26.95
POWER EQUIPMENT OPERATORS	41.18	27.61	28.47
SHEET METAL WORKERS	22.75	20.31	18.40
TRUCK DRIVERS	33.90	21.03	22.19

CERTIFIED: 9/4/14

BY: 
 ADMINISTRATOR, OFFICE OF LABOR LAW ENFORCEMENT

NOTE: THESE RATES ARE PROMULGATED AND ENFORCED PURSUANT TO THE PREVAILING WAGE REGULATIONS ADOPTED BY THE DEPARTMENT OF LABOR ON APRIL 3, 1992.

CLASSIFICATIONS OF WORKERS ARE DETERMINED BY THE DEPARTMENT OF LABOR. FOR ASSISTANCE IN CLASSIFYING WORKERS, OR FOR A COPY OF THE REGULATIONS OR CLASSIFICATIONS, PHONE (302) 451-3423.

NON-REGISTERED APPRENTICES MUST BE PAID THE MECHANIC'S RATE.

PROJECT: 11-PS-02 Assawoman Canal Trail-Phase 1, Sussex County

SECTION 00700 - GENERAL CONDITIONS

General Conditions:

The General Conditions of this Contract are as stated in The American Institute of Architects' AIA Document A201 (2007 Edition) entitled General Conditions of the Contract for Construction and is part of this Project Manual as if herein written in full.

Copies of the Document are available through the Owner.

END OF SECTION 00700 – GENERAL CONDITIONS

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SECTION 00710 - GENERAL REQUIREMENTS

The following GENERAL REQUIREMENTS supplement AIA Document A201 (2007 Edition). In the event of conflict or discrepancies among the Contract Documents, the Documents prepared by the State of Delaware, Division of Parks and Recreation shall take precedence over all other documents.

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ARTICLE 1: GENERAL PROVISIONS

1.1 CONTRACT DOCUMENTS

1.1.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary and what is required by one shall be as binding as if required by all. Performance by the Contractor shall be required to an extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the intended results.

1.1.2 Work including material purchases shall not begin until the Contractor is in receipt of a bonafide State of Delaware Purchase Order. Any work performed or material purchases prior to the issuance of the Purchase Order is done at the Contractor's own risk and cost.

1.2 EQUALITY OF EMPLOYMENT OPPORTUNITY ON PUBLIC WORKS

1.2.1 For Public Works Projects financed in whole or in part by State appropriation, the Contractor agrees that during the performance of this Contract:

- .1 The Contractor will not discriminate against any employee or applicant for employment because of race, creed, color, sex or national origin. The Contractor will take positive steps to ensure that applicants are employed and that employees are treated during employment without regard to their race, creed, color, sex or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or

recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the contracting Agency setting forth this nondiscrimination clause.

- .2 The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that “all qualified applicants will receive consideration for employment without regard to race, creed, color, sex or national origin.”

ARTICLE 2: OWNER

(NO ADDITIONAL GENERAL REQUIREMENTS – SEE SECTION 00800, SUPPLEMENTARY GENERAL CONDITIONS)

ARTICLE 3: CONTRACTOR

- 3.1 Schedule of Values: The successful Bidder shall within twenty (20) days after receiving notice to proceed with the Work, furnish to the Owner a complete schedule of values on the various items comprising the Work.
- 3.2 Subcontracts: Upon approval of Subcontractors, the Contractor shall award their Subcontracts as soon as possible after the signing of their own Contract and see that all material, their own and those of their Subcontractors, are promptly ordered so that the Work will not be delayed by failure of materials to arrive on time.
- 3.3 Before commencing any work or construction, the General Contractor is to consult with the Owner as to matters in connection with access to the site and the allocation of Ground Areas for the various features of hauling, storage, etc.
- 3.4 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract, unless the Contract Documents give other specific instructions.
- 3.5 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Contract. The Contractor shall not permit employment of unfit persons or persons not skilled in tasks assigned to them.
- 3.6 The Contractor warrants to the Owner that materials and equipment furnished will be new and of good quality, unless otherwise permitted, and that the Work will be free from defects and in conformance with the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved, may be considered defective. If required by the Owner, the Contractor shall furnish evidence as to the kind and quality of materials and equipment provided.
- 3.7 Unless otherwise provided, the Contractor shall pay all sales, consumer, use and other similar taxes, and shall secure and pay for required permits, fees, licenses, and inspections necessary for proper execution of the Work.
- 3.8 The Contractor shall comply with and give notices required by laws, ordinances, rules, regulations, and lawful orders of public authorities bearing on performance of the Work. The Contractor shall promptly notify the Owner if the Drawings and Specifications are observed to be at variance therewith.

- 3.9 The Contractor shall be responsible to the Owner for the acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons performing portions of the Work under contract with the Contractor.
- 3.10 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under the Contract. At completion of the Work the Contractor shall remove from and about the Project all waste materials, rubbish, the Contractor's tools, construction equipment, machinery and surplus materials. The Contractor shall be responsible for returning all damaged areas to their original conditions.
- 3.11 STATE LICENSE AND TAX REQUIREMENTS
- 3.11.1 In conformance with Chapter 25, Title 30, Section 2502, any person desiring to engage in business in the State of Delaware shall obtain a license upon making application to the Division of Revenue. This license must be obtained and proof of license compliance must be made prior to, or in conjunction with, the execution of a contract to such person. In the case of contracts in excess of \$50,000 which are competitively bid, such person shall have initiated the license application procedure required by this subsection with the Division of Revenue prior to, or in conjunction with, the submission of a bid on a contract, or, in the case of a Subcontractor, prior to the submission of a bid by the General Contractor.
- 3.11.2 Each Contractor and Subcontractor shall be licensed to do business in the State of Delaware and shall pay all fees and taxes due under State laws. In conformance with Section 2503, Chapter 25, Title 30, Delaware Code, the Contractor "shall furnish the Department of Finance within 10 days after entering into any contract with a contractor or subcontractor not a resident of this State, a statement of the total value of such contract or contracts together with the names and addresses of the contracting parties."
- 3.11.3 The Contractor shall comply with all requirements set forth in Section 6962, Chapter 69, Title 29 of the Delaware Code.

ARTICLE 4: ARCHITECT

- 4.1 CONTRACT SURETY
- 4.1.1 PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND
- 4.1.2 All bonds will be required as follows unless specifically waived elsewhere in the Bidding Documents.
- 4.1.3 Contents of Performance Bonds – The bond shall be in the form approved by the Office of Management and Budget. The bond shall be conditioned upon the faithful compliance and performance by the successful Bidder of each and every term and condition of the Contract and the proposal, Plans, Specifications, and Bid Documents thereof. Each term and condition shall be met at the time and in the manner prescribed by the Contract, Bid Documents and the Specifications, including the payment in full to every person furnishing material or performing labor in the performance of the Contract, of all sums of money due the person for such labor and material. (The bond shall also contain the successful bidder's guarantee to indemnify and save harmless the State and the Agency from all costs, damages and expenses growing out of or by reason of the Contract in accordance with the Contract.)

- 4.1.4 Invoking a Performance Bond – The Agency may, when it considers that the interest of the State so requires, cause judgment to be confessed upon the bond.
- 4.1.5 Within twenty (20) days after the date of notice of award of Contract, the Bidder to whom the award is made shall furnish a Performance Bond and Labor and Material Payment Bond, each equal to the full amount of the Contract price to guarantee the faithful performance of all terms, covenants and conditions of the same. The bonds are to be issued by an acceptable Bonding Company licensed to do business in the State of Delaware and shall be issued in duplicate. In the event a change order is issued which affects total contract price issued, the Contractor shall notify the Surety of the change in contract price and shall show proof of approval to the Agency.
- 4.1.6 Performance and Payment Bonds shall be maintained in full force (warranty bond) for a period of two (2) years after the date of the Certificate for Final Payment. The Performance Bond shall guarantee the satisfactory completion of the Project and that the Contractor will make good any faults or defects in his Work which may develop during the period of said guarantees as a result of improper or defective workmanship, material or apparatus, whether furnished by themselves or their Sub-Contractors. The Payment Bond shall guarantee that the Contractor shall pay in full all persons, firms or corporations who furnish labor or material or both labor and material for, or on account of, the work included herein. The bonds shall be paid for by this Contractor. The Owner shall have the right to demand proof that the parties signing the bonds are duly authorized to do so.

4.2 FAILURE TO COMPLY WITH CONTRACT

- 4.2.1 If any firm entering into a contract with the State, or Agency neglects or refuses to perform or fails to comply with the terms thereof, the Agency which signed the Contract may terminate the Contract and proceed to award a new contract in accordance with Chapter 69, Title 29 of the Delaware Code or may require the Surety on the Performance Bond to complete the Contract in accordance with the terms of the Performance Bond. Nothing herein shall preclude the Agency from pursuing additional remedies as otherwise provided by law.

4.3 CONTRACT INSURANCE AND CONTRACT LIABILITY

- 4.3.1 In addition to the bond requirements stated in the Bid Documents, each successful Bidder shall purchase adequate insurance for the performance of the Contract and, by submission of a Bid, agrees to indemnify and save harmless and to defend all legal or equitable actions brought against the State, any Agency, officer and/or employee of the State, for and from all claims of liability which is or may be the result of the successful Bidder's actions during the performance of the Contract.
- 4.3.2 The purchase or nonpurchase of such insurance or the involvement of the successful Bidder in any legal or equitable defense of any action brought against the successful Bidder based upon work performed pursuant to the Contract will not waive any defense which the State, its agencies and their respective officers, employees and agents might otherwise have against such claims, specifically including the defense of sovereign immunity, where applicable, and by the terms of this section, the State and all agencies, officers and employees thereof shall not be financially responsible for the consequences of work performed, pursuant to said contract.

4.4 RIGHT TO AUDIT RECORDS

- 4.4.1 The Owner shall have the right to audit the books and records of a Contractor or any Subcontractor under any Contract or Subcontract to the extent that the books and records relate to the performance of the Contract or Subcontract.
- 4.4.2 Said books and records shall be maintained by the Contractor for a period of seven (7) years from the date of final payment under the Prime Contract and by the Subcontractor for a period of seven (7) years from the date of final payment under the Subcontract.

ARTICLE 5: SUBCONTRACTORS

5.1 SUBCONTRACTING REQUIREMENTS

- 5.1.1 All contracts for the construction, reconstruction, alteration or repair of any public building (not a road, street or highway) shall be subject to the following provisions:
 - .1 A contract shall be awarded only to a Bidder whose Bid is accompanied by a statement containing, for each Subcontractor category, the name and address (city or town and State only – street number and P.O. Box addresses not required) of the Subcontractor whose services the Bidder intends to use in performing the Work and providing the material for such Subcontractor category.
 - .2 A Bid will not be accepted nor will an award of any Contract be made to any Bidder which, as the Prime Contractor, has listed itself as the Subcontractor for any Subcontractor unless:
 - .1 It has been established to the satisfaction of the awarding Agency that the Bidder has customarily performed the specialty work of such Subcontractor category by artisans regularly employed by the Bidder's firm;
 - .2 That the Bidder is duly licensed by the State to engage in such specialty work, if the State requires licenses; and
 - .3 That the Bidder is recognized in the industry as a bona fide Subcontractor or Contractor in such specialty work and Subcontractor category.
- 5.1.2 The decision of the awarding Agency as to whether a Bidder who lists itself as the Subcontractor for a Subcontractor category shall be final and binding upon all Bidders, and no action of any nature shall lie against any awarding Agency or its employees or officers because of its decision in this regard.
- 5.1.3 After such a Contract has been awarded, the successful Bidder shall not substitute another Subcontractor for any Subcontractor whose name was set forth in the statement which accompanied the Bid without the written consent of the awarding Agency.
- 5.1.4 No Agency shall consent to any substitution of Subcontractors unless the Agency is satisfied that the Subcontractor whose name is on the Bidders accompanying statement:
 - .1 Is unqualified to perform the work required;

- .2 Has failed to execute a timely reasonable Subcontract;
 - .3 Has defaulted in the performance on the portion of the work covered by the Subcontract; or
 - .4 Is no longer engaged in such business.
- 5.1.5 Should a Bidder be awarded a contract, such successful Bidder shall provide to the agency the taxpayer identification license numbers of such subcontractors. Such numbers shall be provided on the later of the date on which such subcontractor is required to be identified or the time the contract is executed. The successful Bidder shall provide to the agency to which it is contracting, within 30 days of entering into such public works contract, copies of all Delaware Business licenses of subcontractors and/or independent contractors that will perform work for such public works contract. However, if a subcontractor or independent contractor is hired or contracted more than 20 days after the Bidder entered the public works contract the Delaware Business license of such subcontractor or independent contractor shall be provided to the agency within 10 days of being contracted or hired.

5.2 PENALTY FOR SUBSTITUTION OF SUBCONTRACTORS

- 5.2.1 Should the Contractor fail to utilize any or all of the Subcontractors in the Contractor's Bid statement in the performance of the Work on the public bidding, the Contractor shall be penalized in the amount of (project specific amount*). The Agency may determine to deduct payments of the penalty from the Contractor or have the amount paid directly to the Agency. Any penalty amount assessed against the Contractor may be remitted or refunded, in whole or in part, by the Agency awarding the Contract, only if it is established to the satisfaction of the Agency that the Subcontractor in question has defaulted or is no longer engaged in such business. No claim for the remission or refund of any penalty shall be granted unless an application is filed within one year after the liability of the successful Bidder accrues. All penalty amounts assessed and not refunded or remitted to the Contractor shall be reverted to the State.

*one (1) percent of contract amount not to exceed \$10,000

5.3 ASBESTOS ABATEMENT

- 5.3.1 The selection of any Contractor to perform asbestos abatement for State-funded projects shall be approved by the Office of Management and Budget, Division of Facilities Management pursuant to Chapter 78 of Title 16.

5.4 STANDARDS OF CONSTRUCTION FOR THE PROTECTION OF THE PHYSICALLY HANDICAPPED

- 5.4.1 All Contracts shall conform with the standard established by the Delaware Architectural Accessibility Board unless otherwise exempted by the Board.

5.5 CONTRACT PERFORMANCE

- 5.5.1 If any firm entering into a Public Works Contract neglects or refuses to perform or fails to comply with its terms, the Agency may terminate the Contract and proceed to award a new Contract or may require the Surety on the Performance Bond to complete the Contract in accordance with the terms of the Performance Bond.

ARTICLE 6: CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

- 6.1 The Owner reserves the right to simultaneously perform other construction or operations related to the Project with the Owner's own forces, and to award separate contracts in connection with other portions of the Project or other projects at the same site.
- 6.2 The Contractor shall afford the Owner and other Contractors reasonable opportunity for access and storage of materials and equipment, and for the performance of their activities, and shall connect and coordinate their activities with other forces as required by the Contract Documents.

ARTICLE 7: CHANGES IN THE WORK

- 7.1 The Owner, without invalidating the Contract, may order changes in the Work consisting of Additions, Deletions, Modifications or Substitutions, with the Contract Sum and Contract completion date being adjusted accordingly. Such changes in the Work shall be authorized by written Change Order signed by the Architect, as the duly authorized agent, the Contractor and the Owner.
- 7.2 The Contract Sum and Contract Completion Date shall be adjusted only by a fully executed Change Order.
- 7.3 The additional cost, or credit to the Owner resulting from a change in the Work shall be by mutual agreement of the Owner, Contractor and the Architect. In all cases, this cost or credit shall be based on the 'DPE' wages required and the "invoice price" of the materials/equipment needed.
- 7.3.1 "DPE" shall be defined to mean "direct personnel expense". Direct payroll expense includes direct salary plus customary fringe benefits (prevailing wage rates) and documented statutory costs such as workman's compensation insurance, Social Security/Medicare, and unemployment insurance (a maximum multiplier of 1.35 times DPE).
- 7.3.2 "Invoice price" of materials/equipment shall be defined to mean the actual cost of materials and/or equipment that is paid by the Contractor, (or subcontractor), to a material distributor, direct factory vendor, store, material provider, or equipment leasing entity. Rates for equipment that is leased and/or owned by the Contractor or subcontractor(s) shall not exceed those listed in the latest version of the "Means Building Construction Cost Data" publication.
- 7.3.3 In addition to the above, the General Contractor is allowed a fifteen percent (15%) markup for overhead and profit for additional work performed by the General Contractor's own forces. For additional subcontractor work, the Subcontractor is allowed a fifteen (15) percent overhead and profit on Change Order work above and beyond the direct costs stated previously. To this amount, the General Contractor will be allowed a mark-up not exceeding seven and one half percent (7.5%) on the subcontractors work. These mark-ups shall include all costs including, but not limited to: overhead, profit, bonds, insurance, supervision, etc. No markup is permitted on the work of the subcontractor's subcontractor. No additional costs shall be allowed for changes related to the Contractor's onsite superintendent/staff, or project manager, unless a change in the work changes the project duration and is identified by the CPM schedule. There will be no other costs associated with the Change Order.

- 7.3.4 Additional work performed by the Contractor without authorization of a Change Order will not entitle him to an increase in the Contract Price or an extension of the Contract Time, except for emergencies as outlined in AIA Document A201, Paragraph 10.4 EMERGENCIES.

ARTICLE 8: TIME

- 8.1 Time limits, if any, are as stated in section *01321 Performance Schedule* in the Project Manual. By executing the Agreement, the Contractor confirms that the stipulated limits are reasonable, and that the Work will be completed within the anticipated time frame.
- 8.2 If progress of the Work is delayed at any time by changes ordered by the Owner, by labor disputes, fire, unusual delay in deliveries, abnormal adverse weather conditions, unavoidable casualties or other causes beyond the Contractor's control, the Contract Time shall be extended for such reasonable time as the Owner may determine.
- 8.3 Any extension of time beyond the date fixed for completion of the construction and acceptance of any part of the Work called for by the Contract, or the occupancy of the building by the Owner, in whole or in part, previous to the completion shall not be deemed a waiver by the Owner of his right to annul or terminate the Contract for abandonment or delay in the matter provided for, nor relieve the Contractor of full responsibility.
- 8.4 SUSPENSION AND DEBARMENT
- 8.4.1 Per Section 6962(d)(14), Title 29, Delaware Code, "Any Contractor who fails to perform a Public Works Contract or complete a Public Works Project within the time schedule established by the Agency in the invitation to bid, may be subject to Suspension or Debarment for one or more of the following reasons: a) failure to supply the adequate labor supply ratio for the project; b) inadequate financial resources; or, c) poor performance on the Project."
- 8.4.2 Upon such failure for any of the above stated reasons, the Agency that contracted for the Public Works Project may petition the Director of the Office of Management and Budget for Suspension or Debarment of the Contractor. The Agency shall send a copy of the petition to the Contractor within three (3) working days of filing with the Director. If the Director concludes that the petition has merit, the Director shall schedule and hold a hearing to determine whether to suspend the Contractor, debar the Contractor or deny the petition. The Agency shall have the burden of proving, by a preponderance of the evidence, that the Contractor failed to perform or complete the Public Works Project within the time schedule established by the Agency and failed to do so for one or more of the following reasons: a) failure to supply the adequate labor supply ratio for the project; b) inadequate financial resources; or, c) poor performance on the project. Upon a finding in favor of the Agency, the Director may suspend a Contractor from Bidding on any project funded, in whole or in part, with public funds for up to 1 year for a first offense, up to 3 years for a second offense and permanently debar the Contractor for a third offense. The Director shall issue a written decision and shall send a copy to the Contractor and the Agency. Such decision may be appealed to the Superior Court within thirty (30) days for a review on the record.
- 8.5 RETAINAGE

- 8.5.1 Per Section 6962(d)(5), Title 29, Delaware Code: The Agency may at the beginning of each Public Works Project establish a time schedule for the completion of the project. If the project is delayed beyond the completion date due to the Contractor's failure to meet their responsibilities, the Agency may hold permanently, at its discretion, all or part of the Contractor's retainage.
- 8.5.2 This forfeiture of retainage also applies to the timely completion of the punchlist. A punchlist will only be prepared upon the mutual agreement of the Owner, Architect and Contractor. Once the punchlist is prepared, all three parties will by mutual agreement, establish a schedule for its completion. Should completion of the punchlist be delayed beyond the established date due to the Contractor's failure to meet their responsibilities, the Agency may hold permanently, at its discretion, all or part of the Contractor's retainage.

ARTICLE 9: PAYMENTS AND COMPLETION

9.1 APPLICATION FOR PAYMENT

- 9.1.1 Applications for payment shall be made upon AIA Document G702.
- 9.1.2 A date will be fixed for the taking of the monthly account of work done. Upon receipt of Contractor's itemized application for payment, such application will be audited, modified, if found necessary, and approved for the amount. Statement shall be submitted to the Owner.
- 9.1.3 Section 6516, Title 29 of the Delaware Code annualized interest is not to exceed 12% per annum beginning thirty (30) days after the "presentment" (as opposed to the date) of the invoice.

9.2 PARTIAL PAYMENTS

- 9.2.1 Any Public Works Contract executed by any Agency may provide for partial payments at the option of the Owner with respect to materials placed along or upon the sites or stored at secured locations, which are suitable for use in the performance of the Contract.
- 9.2.2 When approved by the Agency, partial payment may include the values of tested and acceptable materials of a nonperishable or noncontaminative nature which have been produced or furnished for incorporation as a permanent part of the Work yet to be completed, provided acceptable provisions have been made for storage.
- .1 Any allowance made for materials on hand will not exceed the delivered cost of the materials as verified by invoices furnished by the Contractor, nor will it exceed the contract bid price for the material complete in place.
- 9.2.3 If requested by the Agency, receipted bills from all Contractors, Subcontractors, and materialmen, etc., for the previous payment must accompany each application for payment. Following such a request, no payment will be made until these receipted bills have been received by the Owner.

9.3 SUBSTANTIAL COMPLETION

- 9.3.1 When the building has been made suitable for occupancy, but still requires small items of miscellaneous work, the Owner will determine the date when the Project has been Substantially Completed.
- 9.3.2 If, after the Work has been Substantially Completed, full completion thereof is materially delayed through no fault of the Contractor, and without terminating the Contract, the Owner may make payment of the balance due for the portion of the Work fully completed and accepted. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of claims.
- 9.3.3 On projects where commissioning is included, the commissioning work as defined in the specifications must be complete prior to the issuance of Substantial Completion.

9.4 FINAL PAYMENT

- 9.4.1 Final payment, including the retainage if determined appropriate, shall be made within thirty (30) days after the Work is fully completed and the Contract fully performed and provided that the Contractor has submitted the following closeout documentation (in addition to any other documentation required elsewhere in the Contract Documents):
 - .1 Evidence satisfactory to the Owner that all payrolls, material bills, and other indebtedness connected with the Work have been paid,
 - .2 An acceptable RELEASE OF LIENS,
 - .3 Copies of all applicable warranties,
 - .4 As-built drawings,
 - .5 Operations and Maintenance Manuals,
 - .6 Instruction Manuals,
 - .7 Consent of Surety to final payment.
 - .8 The Owner reserves the right to retain payments, or parts thereof, for its protection until the foregoing conditions have been complied with, defective work corrected and all unsatisfactory conditions remedied.

ARTICLE 10: PROTECTION OF PERSONS AND PROPERTY

- 10.1 The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract. The Contractor shall take all reasonable precautions to prevent damage, injury or loss to: workers, persons nearby who may be affected, the Work, materials and equipment to be incorporated, and existing property at the site or adjacent thereto. The Contractor shall give notices and comply with applicable laws, ordinances, rules, regulations, and lawful orders of public authorities bearing on the safety of persons and property and their protection from injury, damage, or loss. The Contractor shall promptly remedy damage and loss to property at the site caused in whole or in part by the Contractor, a Subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable.

- 10.2 The Contractor shall notify the Owner in the event any existing hazardous material such as lead, PCBs, asbestos, etc. is encountered on the project. The Owner will arrange with a qualified specialist for the identification, testing, removal, handling and protection against exposure or environmental pollution, to comply with applicable regulation laws and ordinances. The Contractor and Architect will not be required to participate in or to perform this operation. Upon completion of this work, the Owner will notify the Contractor and Architect in writing the area has been cleared and approved by the authorities in order for the work to proceed. The Contractor shall attach documentation from the authorities of said approval.
- 10.3 As required in the Hazardous Chemical Information Act of June 1984, all vendors supplying any materials that may be defined as hazardous, must provide Material Safety Data Sheets for those products. Any chemical product should be considered hazardous if it has a warning caution on the label relating to a potential physical or health hazard, if it is known to be present in the work place, and if employees may be exposed under normal conditions or in any foreseeable emergency situation. Material Safety Data Sheets must be provided directly to the Owner along with the shipping slips that include those products.
- 10.4 The Contractor shall certify to the Owner that materials incorporated into the Work are free of all asbestos. This certification may be in the form of Material Safety Data Sheet (MSDS) provided by the product manufacturer for the materials used in construction, as specified or as provided by the Contractor.

ARTICLE 11: INSURANCE AND BONDS

- 11.1 The Contractor shall carry all insurance required by law, such as Unemployment Insurance, etc. The Contractor shall carry such insurance coverage as they desire on their own property such as a field office, storage sheds or other structures erected upon the project site that belong to them and for their own use. The Subcontractors involved with this project shall carry whatever insurance protection they consider necessary to cover the loss of any of their personal property, etc.
- 11.2 Upon being awarded the Contract, the Contractor shall obtain a minimum of two (2) copies of all required insurance certificates called for herein, and submit one (1) copy of each certificate, to the Owner, within 20 days of contract award.
- 11.3 Bodily Injury Liability and Property Damage Liability Insurance shall, in addition to the coverage included herein, include coverage for injury to or destruction of any property arising out of the collapse of or structural injury to any building or structure due to demolition work and evidence of these coverages shall be filed with and approved by the Owner.
- 11.4 The Contractor's Property Damage Liability Insurance shall, in addition to the coverage noted herein, include coverage on all real and personal property in their care, custody and control damaged in any way by the Contractor or their Subcontractors during the entire construction period on this Project.
- 11.5 Builders Risk (including Standard Extended Coverage Insurance) on the existing building during the entire construction period, shall not be provided by the Contractor under this Contract. The Owner shall insure the existing building and all of its contents and all this new alteration work under this Contract during entire construction period for the full insurable value of the entire work at the site. Note, however, that the Contractor and their Subcontractors shall be responsible for insuring building materials (installed and stored) and their tools and equipment whenever in use on the project, against fire damage, theft, vandalism, etc.

11.6 Certificates of the insurance company or companies stating the amount and type of coverage, terms of policies, etc., shall be furnished to the Owner, within 20 days of contract award.

11.7 The Contractor shall, at their own expense, (in addition to the above) carry the following forms of insurance:

11.7.1 Contractor's Contractual Liability Insurance

Minimum coverage to be:

Bodily Injury	\$ 500,000 \$1,000,000 \$1,000,000	for each person for each occurrence aggregate
Property Damage	\$ 500,000 \$1,000,000	for each occurrence aggregate

11.7.2 Contractor's Protective Liability Insurance

Minimum coverage to be:

Bodily Injury	\$ 500,000 \$1,000,000 \$1,000,000	for each person for each occurrence aggregate
Property Damage	\$ 500,000 \$ 500,000	for each occurrence aggregate

11.7.3 Automobile Liability Insurance

Minimum coverage to be:

Bodily Injury	\$1,000,000 \$1,000,000	for each person for each occurrence
Property Damage	\$ 500,000	per accident

11.7.4 Prime Contractor's and Subcontractors' policies shall include contingent and contractual liability coverage in the same minimum amounts as 11.7.1 above.

11.7.5 Workmen's Compensation (including Employer's Liability):

- .1 Minimum Limit on employer's liability to be as required by law.
- .2 Minimum Limit for all employees working at one site.

11.7.6 Certificates of Insurance must be filed with the Owner guaranteeing fifteen (15) days prior notice of cancellation, non-renewal, or any change in coverages and limits of liability shown as included on certificates.

11.7.7 Social Security Liability

- .1 With respect to all persons at any time employed by or on the payroll of the Contractor or performing any work for or on their behalf, or in connection with or arising out of the Contractor's business, the Contractor shall accept full and exclusive liability for the payment of any and all contributions or taxes or

unemployment insurance, or old age retirement benefits, pensions or annuities now or hereafter imposed by the Government of the United States and the State or political subdivision thereof, whether the same be measured by wages, salaries or other remuneration paid to such persons or otherwise.

- .2 Upon request, the Contractor shall furnish Owner such information on payrolls or employment records as may be necessary to enable it to fully comply with the law imposing the aforesaid contributions or taxes.
- .3 If the Owner is required by law to and does pay any and/or all of the aforesaid contributions or taxes, the Contractor shall forthwith reimburse the Owner for the entire amount so paid by the Owner.

ARTICLE 12: UNCOVERING AND CORRECTION OF WORK

- 12.1 The Contractor shall promptly correct Work rejected by the Owner or failing to conform to the requirements of the Contract Documents, whether observed before or after Substantial Completion and whether or not fabricated, installed or completed, and shall correct any Work found to be not in accordance with the requirements of the Contract Documents within a period of two years from the date of Substantial Completion, or by terms of an applicable special warranty required by the Contract Documents. The provisions of this Article apply to work done by Subcontractors as well as to Work done by direct employees of the Contractor.
- 12.2 At any time during the progress of the Work, or in any case where the nature of the defects shall be such that it is not expedient to have them corrected, the Owner, at their option, shall have the right to deduct such sum, or sums, of money from the amount of the Contract as they consider justified to adjust the difference in value between the defective work and that required under Contract including any damage to the structure.

ARTICLE 13: MISCELLANEOUS PROVISIONS

13.1 CUTTING AND PATCHING

- 13.1.1 The Contractor shall be responsible for all cutting and patching. The Contractor shall coordinate the work of the various trades involved.

13.2 DIMENSIONS

- 13.2.1 All dimensions shown shall be verified by the Contractor by actual measurements at the Project site. Any discrepancies between the Drawings and Specifications and the existing conditions shall be referred to the Owner for adjustment before any work affected thereby has been performed.

13.3 LABORATORY TESTS

- 13.3.1 Any specified laboratory tests of material and finished articles to be incorporated in the Work shall be made by bureaus, laboratories or agencies approved by the Owner and reports of such tests shall be submitted to the Owner. The cost of the testing shall be paid for by the Contractor.
- 13.3.2 The Contractor shall furnish all sample materials required for these tests and shall deliver same without charge to the testing laboratory or other designated agency when and where directed by the Owner.

13.4 ARCHAEOLOGICAL EVIDENCE

13.4.1 Whenever in the course of construction any archaeological evidence is encountered on the surface or below the surface of the ground, the Contractor shall notify the Owner and the authorities of the State Historic Preservation Office and suspend work in the immediate area for a reasonable time to permit those authorities or persons designated by the Owner, to ascertain its historic and cultural significance and to determine the need for compliance with the relevant State and Federal law and policies.

13.5 GLASS REPLACEMENT AND CLEANING

13.5.1 The General Contractor shall replace without expense to the Owner all glass broken during the construction of the project. If job conditions warrant, at completion of the job the General Contractor shall have all glass cleaned and polished.

13.6 WARRANTY

13.6.1 For a period of two (2) years from the date of Substantial Completion, as evidenced by the date of final acceptance of the work, the Contractor warrants that work performed under this Contract conforms to the Contract requirements and is free of any defect of equipment, material or workmanship performed by the Contractor or any of his subcontractors or suppliers. However, manufacturer's warranties and guarantees, if for a period longer than two (2) years, shall take precedence over the above warranties. The Contractor shall remedy, at his own expense, any such failure to conform or any such defect. The protection of this warranty shall be included in the Contractor's Performance Bond.

ARTICLE 14: TERMINATION OR SUSPENSION OF THE CONTRACT

14.1 If the Contractor defaults or persistently fails or neglects to carry out the Work in accordance with the Contract Documents or fails to perform a provision of the Contract, the Owner, after seven days written notice to the Contractor, may make good such deficiencies and may deduct the cost thereof from the payment then or thereafter due the Contractor. Alternatively, at the Owner's option, and the Owner may terminate the Contract and take possession of the site and of all materials, equipment, tools, and machinery thereon owned by the Contractor and may finish the Work by whatever method the Owner may deem expedient. If the costs of finishing the Work exceed any unpaid compensation due the Contractor, the Contractor shall pay the difference to the Owner.

14.2 If the continuation of this Agreement is contingent upon the appropriation of adequate State, or federal funds, this Agreement may be terminated on the date beginning on the first fiscal year for which funds are not appropriated or at the exhaustion of the appropriation. The Owner may terminate this Agreement by providing written notice to the parties of such non-appropriation. All payment obligations of the Owner will cease upon the date of termination. Notwithstanding the foregoing, the Owner agrees that it will use its best efforts to obtain approval of necessary funds to continue the Agreement by taking appropriate action to request adequate funds to continue the Agreement.

END OF SECTION 00710 - GENERAL REQUIREMENTS

SECTION 00800 - SUPPLEMENTARY GENERAL CONDITIONS

The following supplements modify the "General Conditions of the Contract for Construction," AIA Document A201-2007. Where a portion of the General Conditions is modified or deleted by the Supplementary General Conditions, the unaltered portions of the General Conditions shall remain in effect.

TABLE OF ARTICLES

1. GENERAL PROVISIONS
2. OWNER
3. CONTRACTOR
4. ARCHITECT
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6. CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS
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13. MISCELLANEOUS PROVISIONS
14. TERMINATION OR SUSPENSION OF THE CONTRACT
15. CLAIMS AND DISPUTES

ARTICLE 1: GENERAL PROVISIONS

1.1 BASIC DEFINITIONS

1.1.1 THE CONTRACT DOCUMENTS

Delete the last sentence in its entirety and replace with the following:

"The Contract Documents also include Advertisement for Bid, Instructions to Bidders, sample forms, the Bid Form, the Contractor's completed Bid and the Award Letter."

Add the following clause:

- 1.1.1.1 In the event of conflict or discrepancies among the Contract Documents, the Documents prepared by the State of Delaware, Division of Parks and Recreation shall take precedence over all other documents.

1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

Add the following subparagraphs:

- 1.2.4 In the case of an inconsistency between the Drawings and the Specifications, or within either document not clarified by Addendum, the better quality or greater quantity of work shall be provided in accordance with the Architect's interpretation.

1.2.5 The word “PROVIDE” as used in the Contract Documents shall mean “FURNISH AND INSTALL” and shall include, without limitation, all labor, materials, equipment, transportation, services and other items required to complete the Work.

1.2.6 The word “PRODUCT” as used in the Contract Documents means all materials, systems and equipment.

1.5 OWNERSHIP AND USE OF DRAWINGS, SPECIFICATIONS AND OTHER INSTRUMENTS OF SERVICE

Delete subparagraph 1.5.1 in its entirety and replace with the following:

“All pre-design studies, drawings, specifications and other documents, including those in electronic form, prepared by the Architect under this Agreement are, and shall remain, the property of the Owner whether the Project for which they are made is executed or not. Such documents may be used by the Owner to construct one or more like Projects without the approval of, or additional compensation to, the Architect. The Contractor, Subcontractors, Sub-subcontractors and Material or Equipment Suppliers are authorized to use and reproduce applicable portions of the Drawings, Specifications and other documents prepared by the Architect and the Architect’s consultants appropriate to and for use in the execution of their Work under the Contract Documents. They are not to be used by the Contractor or any Subcontractor, Sub-subcontractor or Material and Equipment Supplier on other projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner, Architect and Architect’s consultants.

The Architect shall not be liable for injury or damage resulting from the re-use of drawings and specifications if the Architect is not involved in the re-use project. Prior to re-use of construction documents for a project in which the Architect is not also involved, the Owner will remove from such documents all identification of the original Architect, including name, address and professional seal or stamp.”

Delete subparagraph 1.5.2 in its entirety.

ARTICLE 2: OWNER

2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER

To subparagraph 2.2.3 – Add the following sentence:

“The Contractor, at their expense shall bear the costs to accurately identify the location of all underground utilities in the area of their excavation and shall bear all cost for any repairs required, out of failure to accurately identify said utilities.”

Delete subparagraph 2.2.5 in its entirety and substitute the following:

2.2.5 The Contractor will be furnished, free of charge, a specified number of copies of Drawings and Project Manuals. Refer to Section 01005, ADMINISTRATIVE PROVISIONS. Additional sets will be furnished at the cost of reproduction, postage and handling.

ARTICLE 3: CONTRACTOR

3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

Amend subparagraph 3.2.2 to state that any errors, inconsistencies or omissions discovered shall be reported to the Architect and Owner immediately.

Delete the third sentence in subparagraph 3.2.4.

3.3 SUPERVISION AND CONSTRUCTION PROCEDURES

Add the following clause to subparagraph 3.3.2:

3.3.2.1 The Contractor shall immediately remove from the Work, whenever requested to do so by the Owner, any person who is considered by the Owner or Architect to be incompetent or disposed to be so disorderly, or who for any reason is not satisfactory to the Owner, and that person shall not again be employed on the Work without the consent of the Owner or the Architect.

Add the following subparagraphs:

3.3.4 The Contractor must provide suitable storage facilities at the Site for the proper protection and safe storage of their materials. Consult the Owner and the Architect before storing any materials.

3.3.5 When any room is used as a shop, storeroom, office, etc., by the Contractor or Subcontractor(s) during the construction of the Work, the Contractor making use of these areas will be held responsible for any repairs, patching or cleaning arising from such use.

3.4 LABOR AND MATERIALS

Add the following subparagraphs:

3.4.4 Before starting the Work, each Contractor, or Subcontractor, shall carefully examine all preparatory Work that has been executed to receive their Work. Check carefully, by whatever means are required, to insure that its Work and adjacent, related Work, will finish to proper contours, planes and levels. Promptly notify the General Contractor/Construction Manager of any defects or imperfections in preparatory Work which will in any way affect satisfactory completion of its Work. Absence of such notification will be construed as an acceptance of preparatory Work and later claims of defects will not be recognized.

3.4.5 Under no circumstances shall the Contractor's Work proceed prior to preparatory Work having been completely cured, dried and/or otherwise made satisfactory to receive this Work. Responsibility for timely installation of all materials rests solely with the Contractor responsible for that Work, who shall maintain coordination at all times.

3.5 WARRANTY

Add the following subparagraphs:

3.5.1 The Contractor will guarantee all materials and workmanship against original defects, except injury from proper and usual wear when used for the purpose intended, for two years after Acceptance by the Owner, and will maintain all items in perfect condition during the period of guarantee.

- 3.5.2 Defects appearing during the period of guarantee will be made good by the Contractor at his expense upon demand of the Owner, it being required that all Work will be in perfect condition when the period of guarantee will have elapsed.
- 3.5.3 In addition to the General Guarantee there are other guarantees required for certain items for different periods of time than the two years as above, and are particularly so stated in that part of the specifications referring to same. The said guarantees will commence at the same time as the General Guarantee.
- 3.5.4 If the Contractor fails to remedy any failure, defect or damage within a reasonable time after receipt of notice, the Owner will have the right to replace, repair, or otherwise remedy the failure, defect or damage at the expense of the Contractor and/or his surety.

3.11 DOCUMENTS AND SAMPLES AT THE SITE

Add the following subparagraphs:

- 3.11.1 During the course of the Work, the Contractor shall maintain a record set of drawings on which the Contractor shall mark the actual physical location of all piping, valves, equipment, conduit, outlets, access panels, controls, actuators, including all appurtenances that will be concealed once construction is complete, etc., including all invert elevations.
- 3.11.2 At the completion of the Project, the Contractor shall obtain a set of reproducible drawings from the Architect, and neatly transfer all information outlined in 3.11.1 to provide a complete record of the as-built conditions.
- 3.11.3 The Contractor shall provide two (2) prints of the as-built conditions, along with the reproducible drawings themselves, to the Owner and one (1) set to the Architect. In addition, attach one complete set to each of the Operating and Maintenance Instructions/Manuals.

3.13 USE OF SITE

Add the following new subparagraphs:

- 3.13.1 The Contractor will not load nor permit any part of the structure to be loaded with weight that will endanger the structure.
- 3.13.2 Storage areas will be defined for the storage of the Contractor's materials and equipment and he shall confine his materials, equipment, and operations of his workmen to such limits as indicated by the Owner. Unless otherwise indicated in the Specifications, the storage areas will be outdoors, and the contractor shall provide whatever shelter is necessary for his storage and fabricating needs. No workmen shall trespass within areas or buildings of the Owner other than those related to the Work of the Contract. The Contractor shall rigidly enforce this regulation. Any materials, equipment or temporary structures belonging to the Contractor shall be moved when so directed by the Owner to permit the execution of the work of others in connection with the Project. Storage areas shall be visually screened on any side facing existing residential properties. All storage areas to be restored to pre-existing condition at the conclusion of construction activities.

3.17 ROYALTIES, PATENTS AND COPYRIGHTS

In the second sentence of the paragraph, insert “indemnify and” between “shall” and “hold”.

ARTICLE 4: ARCHITECT

4.2 ADMINISTRATION OF THE CONTRACT

Delete the first sentence of subparagraph 4.2.7 and replace with the following:

The Architect will review and approve or take other appropriate action upon the Contractor’s submittals such as Shop Drawings, Product Data and Samples for the purpose of checking for conformance with the Contract Documents.

Delete the second sentence of subparagraph 4.2.7 and replace with the following:

The Architect’s action will be taken with such reasonable promptness as to cause no delay in the Work or in the activities of the Owner, Contractor or separate Contractors, while allowing sufficient time in the Owner’s professional judgment to permit adequate review.

Add the following clause to subparagraph 4.2.10:

4.2.10.1 There will be no full-time project representative provided by the Owner or Architect on this project.

Add to subparagraph 4.2.13 “and in compliance with all local requirements.” to the end of the sentence.

ARTICLE 5: SUBCONTRACTORS

5.2 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK

Delete subparagraph 5.2.3 in its entirety and replace with the following:

5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection, subject to the statutory requirements of 29 Delaware Code § 6962(d)(10)b.3 and 4.

ARTICLE 6: CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

6.1 OWNER’S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS

Delete Paragraph 6.1.4 in its entirety.

6.2 MUTUAL RESPONSIBILITY

6.2.3 In the second sentence, strike the word “shall” and insert the word “may”.

Add the following Paragraph to Article 6:

6.4 DEPARTMENT FURNISHED MATERIALS AND EQUIPMENT

- 6.4.1 If any materials or equipment are to be furnished by the Owner for the Work, they will be so specified in the Contract Documents. Unless otherwise specified, it shall be the Contractor's responsibility to locate, receive, handle and store, if necessary, any item of Owner furnished material or equipment which he is required by the Contract to install, erect or handle in any way, from the time it is received by the Contractor at the jobsite or other Owner approved location until completion of the Work in accordance with the Contract Documents. Damaged or lost Owner furnished items shall be repaired or replaced by the Contractor without additional cost to the Owner. See Section 01005, ADMINISTRATIVE PROVISIONS for list of Owner furnished materials and equipment.

ARTICLE 7: CHANGES IN THE WORK

(SEE ARTICLE 7: CHANGES IN WORK IN THE GENERAL REQUIREMENTS)

ARTICLE 8: TIME

8.2 PROGRESS AND COMPLETION

Add the following clause to subparagraph 8.2.1:

- 8.2.1.1 Refer to Specification Section 01321, Performance Schedule for Contract time requirements.

Add the following new subparagraph:

- 8.2.4 If the Work falls behind the Progress Schedule as submitted by the Contractor, the Contractor shall employ additional labor and/or equipment necessary to bring the Work into compliance with the Progress Schedule at no additional cost to the Owner.

8.3 DELAYS AND EXTENSIONS OF TIME

- 8.3.1 Strike "arbitration" and insert "remedies at law or in equity".

Add the following clause to subparagraph 8.3.2:

- 8.3.2.1 The Contractor shall update the status of the suspension, delay, or interruption of the Work with each Application for Payment. (The Contractor shall report the termination of such cause immediately upon the termination thereof.) Failure to comply with this procedure shall constitute a waiver for any claim for adjustment of time or price based upon said cause.

Delete subparagraph 8.3.3 in its entirety and replace with the following:

- 8.3.3 Except in the case of a suspension of the Work directed by the Owner, an extension of time under the provisions of Paragraph 8.3.1 shall be the Contractor's sole remedy in the progress of the Work and there shall be no payment or compensation to the Contractor for any expense or damage resulting from the delay.

Add the following subparagraph:

- 8.3.4 By permitting the Contractor to work after the expired time for completion of the Project, the Owner does not waive their rights under the Contract.

ARTICLE 9: PAYMENTS AND COMPLETION

9.2 SCHEDULE OF VALUES

Add the following subparagraphs:

- 9.2.1 The Schedule of Values shall be submitted using AIA Document G703, Continuation Sheet to G702.
- 9.2.2 The Schedule of Values is to include a line item for Project Closeout Document Submittal. The value of this item is to be no less than 1% of the initial contract amount.

9.3 APPLICATIONS FOR PAYMENT

Add the following clause to subparagraph 9.3.1:

- 9.3.1.3 Application for Payment shall be submitted on AIA Document G702 “Application and Certificate for Payment”, supported by AIA Document G703 “Continuation Sheet”. Said Applications shall be fully executed and notarized.

Add the following subparagraphs:

- 9.3.4 Until the Work is 90% complete, the owner will pay 95% of the value of completed Work, based on the Contract prices of labor and materials incorporated in the Work and of materials suitably stored at the site thereof up to the last day of the preceding month as estimated by the Architect, less the aggregate of previous payments. At the time the Work is 90% complete, if the manner of completion of the Work and its progress are and remain satisfactory to the Architect, and in the absence of other good and sufficient reasons, as provided in GENERAL REQUIREMENTS 8.5 RETAINAGE, the Architect shall, on presentation by the Contractor of Consent of Surety, certify for payment to the Contractor half the funds being held as retainage by the Owner. Thereafter, the Owner will pay 97.5% of the amount due the Contractor on account of remaining progress payments.
- 9.3.5 The Contractor shall provide a current and updated Progress Schedule to the Architect with each Application for Payment. Failure to provide Schedule will be just cause for rejection of Application for Payment.

9.5 DECISIONS TO WITHHOLD CERTIFICATION

Add the following clauses to subparagraph 9.5.1:

- .8 failure to provide a current Progress Schedule;
- .9 a lien or attachment is filed;
- .10 failure to comply with mandatory requirements for maintaining Record Documents.

9.6 PROGRESS PAYMENTS

Delete subparagraph 9.6.1 in its entirety and replace with the following:

9.6.1 After the Architect has approved and issued a Certificate for Payment, payment shall be made by the Owner within 30 days after Owner's receipt of the Certificate for Payment.

9.7 FAILURE OF PAYMENT

In first sentence, strike "seven" and insert "thirty (30)". Also strike "binding dispute resolution" and insert "remedies at law or in equity".

9.8 SUBSTANTIAL COMPLETION

Add the following sentence to Subparagraph 9.8.3:

"If the Architect is required to make more than 2 inspections of the same portion of Work, the Contractor shall be responsible for all costs associated with subsequent inspections including but not limited to any Architect's fees."

9.8.5 In the second sentence, strike "shall" and insert "may".

ARTICLE 10: PROTECTION OF PERSONS AND PROPERTY

10.1 SAFETY PRECAUTIONS AND PROGRAMS

Add the following subparagraphs:

10.1.1 Each Contractor shall develop a Safety Program in accordance with the Occupational Safety and Health Act of 1970. A copy of said plan shall be furnished to the Owner and Architect prior to the commencement of that Contractor's Work.

10.1.2 Each Contractor shall appoint a Safety Representative. Safety Representatives shall be someone who is on site on a full time basis. If deemed necessary by the Owner or Architect, Contractor Safety Meetings will be scheduled. The attendance of all Safety Representatives will be required. Minutes will be recorded of said meetings by the Contractor and will be distributed to all parties as well as posted in all job offices/trailers etc.

10.3 HAZARDOUS MATERIALS

Delete subparagraph 10.3.3 in its entirety.

Delete subparagraph 10.3.6 in its entirety.

ARTICLE 11: INSURANCE AND BONDS

11.1 CONTRACTOR'S LIABILITY INSURANCE

11.1.4 Strike "the Owner" immediately following "(1)" and strike "and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's completed operations."

11.2 OWNER'S LIABILITY INSURANCE

Delete Paragraph 11.2 in its entirety.

11.3 PROPERTY INSURANCE

Delete Paragraph 11.3 in its entirety and replace with the following:

11.3 The State will not provide Builder's All Risk Insurance for the Project. The Contractor and all Subcontractors shall provide property coverage for their tools and equipment, as necessary. Any mandatory deductible required by the Contractor's Insurance shall be the responsibility of the Contractor.

11.4 PERFORMANCE BOND AND PAYMENT BOND

Add the following sentence to subparagraph 11.4.1:

"The bonds will conform to those forms approved by the Office of Management and Budget."

ARTICLE 12: UNCOVERING AND CORRECTION OF WORK

12.2 CORRECTION OF WORK

12.2.2 AFTER SUBSTANTIAL COMPLETION

12.2.2.1 Strike "one year" and insert "two years".
Strike "one-year" and insert "two-year".

Add the following subclause to clause 12.2.2.1:

12.2.2.1.1 At any time during the progress of the Work, or in any case where the nature of the defects will be such that it is not expedient to have corrected, the Owner, at its option, will have the right to deduct such sum, or sums, of money from the amount of the Contract as it considers justified to adjust the difference in value between the defective work and that required under Contract including any damage to the structure.

12.2.2.2 Strike "one" and insert "two".

12.2.2.3 Strike "one" and insert "two".

12.2.5 In second sentence, strike "one" and insert "two".

ARTICLE 13: MISCELLANEOUS PROVISIONS

13.1 GOVERNING LAW

Strike "except that, if the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4."

13.6 INTEREST

Strike "the date payment is due at such rate as the parties may agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located." Insert "30 days of presentment of the authorized Certificate of Payment at the annual rate of 12% or 1% per month.

13.7 TIME LIMITS ON CLAIMS

Strike the last sentence.

Add the following Paragraph:

13.8 CONFLICTS WITH FEDERAL STATUTES OR REGULATIONS

- 13.8.1 If any provision, specifications or requirement of the Contract Documents conflict or is inconsistent with any statute, law or regulation of the government of the United State of America, the Contractor shall notify the Architect and Owner immediately upon discovery.

ARTICLE 14: TERMINATION OR SUSPENSION OF THE CONTRACT

14.4 TERMINATION BY THE OWNER FOR CONVENIENCE

Delete subparagraph 14.4.3 in its entirety and replace with the following:

- 14.4.3 In case of such termination for the Owner's convenience, the Contractor shall be entitled to receive payment for Work executed, and cost incurred by reason of such termination along with reasonable overhead.

ARTICLE 15: CLAIMS AND DISPUTES

15.1 CLAIMS

- 15.1.2 Throughout the Paragraph strike "21" and insert "45".

Delete subparagraph 15.1.6 in its entirety.

15.2 INITIAL DECISION

Delete subparagraph 15.2.5 in its entirety and replace with the following:

- 15.2.5 The Architect will approve or reject Claims by written decision, which shall state the reasons therefore and shall notify the parties of any change in the Contract Sum or Contract Time or both. The approval or rejection of a Claim by the Architect shall be subject to mediation and other remedies at law or in equity.

Delete subparagraph 15.2.6 and its clauses in their entirety.

15.3 MEDIATION

- 15.3.1 Strike "binding dispute resolution" and insert "any or all remedies at law or in equity".

- 15.3.2 In the first sentence, delete "administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement," Strike "binding dispute resolution" and insert "remedies at law and in equity".

15.4 ARBITRATION

Delete subparagraph 15.4 and its subparagraphs in their entirety.

END OF SECTION 00800 - SUPPLEMENTARY GENERAL CONDITIONS

SECTION 00850 - DRAWING INDEX

(List all Drawing numbers and titles below)

<u>Sheet No</u>	<u>Title</u>
Cover	COVER SHEET
C-001	GENERAL NOTES & LEGEND
C-101 - 103	EXISTING CONDITIONS PLANS
C-201 - 203	PROPOSED TRAIL SITE PLANS
C-204	PROPOSED SITE PLAN – TOWN ROAD
C-500	SEDIMENT AND STORMWATER MANAGEMENT PLANS - COVER
C-501	OVERALL CONSTRUCTION SITE STORMWATER MANAGEMENT PLAN
C-502 - 504	CONSTRUCTION SITE STORMWATER MANAGEMENT PLANS
C-505 - 507	SEDIMENT AND STORMWATER DETAILS & NOTES
C-601	CENTRAL AVENUE TRAIL CROSSING PLAN
C-602	ROUTE 26 TRAIL CONNECTION AND M.O.T. PLAN
C-901 - 902	SITE CONSTRUCTION DETAILS
C-903	BUILDING CONSTRUCTION DETAILS
L-101- 102	TREE PROTECTION PLANS
L-103	TYPICAL VISUAL BUFFER AND LANDSCAPE PLAN
L-104	LANDSCAPE DETAILS AND NOTES
L-105	TRAIL HEAD PARKING LOT LANDSCAPE PLAN
S-100	STRUCTURAL NOTES
S-101	BRIDGE PLAN, ELEVATIONS & DETAILS
E-100	ELECTRICAL SITE PLAN & NOTES

END OF SECTION 00850 – DRAWING INDEX

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SECTION 01005 - ADMINISTRATIVE PROVISIONS**TABLE OF ARTICLES**

1. WORK COVERED BY THE CONTRACT DOCUMENTS
2. CONTRACT METHOD
3. WORK SEQUENCE
4. CONTRACTOR USE OF PREMISES
5. OWNER OCCUPANCY
6. OWNER-FURNISHED PRODUCTS
7. ALLOWANCES
8. ALTERNATES
9. UNIT PRICES
10. APPLICATIONS FOR PAYMENT
11. OWNER SUPPLIED CONSTRUCTION DOCUMENTS
12. COORDINATION
13. FIELD ENGINEERING
14. REFERENCE STANDARDS

ARTICLE 1: WORK COVERED BY CONTRACT DOCUMENTS

- 1.1 The work includes, but is not necessarily limited to, construction of approximately 5,000 linear feet of 8' wide stone shared use path, pedestrian bridge, trailhead with 10 space permeable parking lot and restroom, miscellaneous site amenities associated work and all else required to complete the Project in accordance with the Drawings and Specifications.

ARTICLE 2: CONTRACT METHOD

- 2.1 Construct the Work under a single, Lump Sum Contract.
- 2.2 Items noted "NIC" (Not in Contract), will be furnished and installed by others.

ARTICLE 3: WORK SEQUENCE

- 3.1 Construct Work in stages to accommodate Owner's occupancy requirements during the construction period; coordinate construction schedule and operations.
- 3.2 Begin Work within seven (7) days after issuance of a State purchase order and Notice to Proceed and be Substantially Completed by May 8th, 2015.

ARTICLE 4: CONTRACTOR USE OF PREMISES

- 4.1 Limit use of premises for work and for construction operations to allow for Owner occupancy.
- 4.2 Coordinate use of premises under direction of Owner.

ARTICLE 5: OWNER OCCUPANCY

- 5.1 Owner will occupy premises during entire period of construction for the conduct of his normal operations. Cooperate with Owner to minimize conflict, and to facilitate Owner's operations.

ARTICLE 6: OWNER-FURNISHED PRODUCTS

6.1 None

ARTICLE 7: ALLOWANCES

7.1 None

ARTICLE 8: ALTERNATES *(If none, Delete the following and enter None)*

8.1 None

ARTICLE 9: UNIT PRICES

9.1 Unit Prices quoted on Bid Forms will be exercised as Owner option.

9.2 Coordinate related work and modify surrounding work affected by accepted Unit Prices as required to complete the Work.

9.3 Schedule of Unit Prices: (Refer to Bid Form and Section 01026 - Unit Prices)

ARTICLE 10: APPLICATIONS FOR PAYMENT

10.1 Submit 3 copies of each application under procedures of Sections 00710 and 00800.

10.2 Content and Format: Use table of contents of Project Manual.

ARTICLE 11: OWNER SUPPLIED CONSTRUCTION DOCUMENTS

11.1 The Contractor will be furnished, free of charge five (5) copies of Drawings and Project Manuals (or less if requested). Additional sets will be furnished at the cost of reproduction, postage and handling.

ARTICLE 12: COORDINATION

12.1 Coordinate Work of the various sections of Specifications to assure efficient and orderly sequence of installation of construction elements, with provisions for accommodating items installed later.

12.2 Verify characteristics of elements of interrelated operating equipment are compatible; coordinate Work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

12.3 Coordinate space requirements and installation of mechanical, electrical and plumbing work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduits, as closely as practicable; make runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

12.4 In finished areas (except as otherwise shown), conceal pipes, ducts, and wiring in the construction. Coordinate locations of fixtures and outlets with finish elements.

12.5 Execute cutting and patching to integrate elements of Work, uncover ill-timed defective and non-conforming work, provide openings for penetrations of existing surfaces, and provide samples for testing. Seal penetrations through floors, walls, and ceilings.

ARTICLE 13: FIELD ENGINEERING

13.1 Provide field engineering services; establish grades, lines, and levels, by use of recognized engineering survey practices.

- 13.2 Control datum for survey is that shown on drawings. Locate and protect control and reference points.

ARTICLE 14: REFERENCE STANDARDS

- 14.1 For products specified by association or trade standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- 14.2 The date of the standard is that in effect as of the Bid date, except when a specific date is specified.
- 14.3 Obtain copies of standards when required by Contract Documents. Maintain copy at job site during progress of the specific work.

END OF SECTION 01005 – ADMINISTRATIVE PROVISIONS

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SECTION 01010 - SUMMARY OF WORK

TABLE OF ARTICLES

1. PROJECT DESCRIPTION
2. WORK SEQUENCE
3. SPECIFIC PROJECT REQUIREMENTS
4. CONTRACTOR USE OF PREMISES

ARTICLE 1: PROJECT DESCRIPTION

- 1.1 The Contractor for this Project shall furnish all labor, materials, equipment and services necessary for and reasonably incidental to fully perform all the Work indicated as their responsibility and as shown on the Drawings and specified in the Specifications.
- 1.2 The Work shall include the following:
Construction of approximately 5,100 linear feet of 8' wide stone shared use path, one road connection, one road crossing, pedestrian bridge, trailhead with 10 space permeable parking lot and restroom, miscellaneous site amenities and associated work., as shown on the Drawings and as specified in the Specification Manual, including, but not necessarily limited to the following.
 - 1.2.1 Eight foot wide stone shared use path.
 - 1.2.2 Helical anchor supported pedestrian bridge.
 - 1.2.3 Permeable Trailhead parking lot and vehicular entrance.
 - 1.2.4 Trailhead restroom, plaza and associated appurtenances.
 - 1.2.5 Route 26 sidewalk connection and concrete trail section.
 - 1.2.6 Central Avenue road crossing.
 - 1.2.7 Landscaping
 - 1.2.8 Associated grading, site maintenance, E&S and stormwater management.
 - 1.2.9 Associated appurtenances and amenities

ARTICLE 2: WORK SEQUENCE

- 2.1 The Work will be conducted in one phase to provide the least possible interference to the activities of the Owner's personnel and to permit an orderly transfer of personnel and equipment to the new facilities.
- 2.2 Bidders must account for a rolling area of disturbance and construction. Specifically, areas disturbed must be stabilized, to the satisfaction of DNREC Sediment and Stormwater Staff, on a daily basis. All trail construction disturbance shall be done in daily phases, disturbing area that will be constructed and stabilized on a daily basis. Failure to follow a daily disturb and stabilize construction method will require the installation of erosion control measures as required by DNREC Sediment and Stormwater requirements, along the whole project limit of disturbance boundary. This large additional cost shall be borne by the Contractor and completed at no expense to the Owner.
- 2.3 Work shall be substantially complete by May 8, 2015.

ARTICLE 3: SPECIFIC PROJECT REQUIREMENTS

- 3.1 Most of the trail construction occurs within a 16 liner foot wide area of disturbance. To accomplish this work, Contractor must account for the procurement and use of appropriately

sized equipment. Equipment must be able to complete the work within identified limits of disturbance and without damaging adjacent property and vegetation.

- 3.2 The Owner has facilitated the temporary use of a parcel for construction material storage and trail access, off of Osprey Lane. The use of this parcel must follow requirements provided on the contract drawings and other contract documents. The site must be visually screened during use and returned to pre-existing condition following construction activities.
- 3.3 Contractor shall make every attempt to identify private utilities run from adjacent residential parcels, into the project area. Upon discovery, Contractor shall notify Owner. Owner shall coordinate communication with adjacent landowners and direct Contractor in removal and abandonment of said utilities within project limit of disturbance.
- 3.4 Working Hours: Allowable onsite working hours shall be from 7:00 a.m. to 7:00 p.m., Monday through Friday.

ARTICLE 4: CONTRACTOR USE OF PREMISES

- 4.1 General: Limit use of the premises to construction activities in areas indicated.
 - 4.1.1 Confine operations to areas within Contract limits indicated.

END OF SECTION 01010 - SUMMARY OF WORK

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SECTION 01026 - UNIT PRICES

TABLE OF ARTICLES

1. RELATED DOCUMENTS
2. SUMMARY
3. UNIT PRICE SCHEDULE

ARTICLE 1: RELATED DOCUMENTS

- 1.1 Drawings and general provisions of the Contract, including General Conditions, Supplementary General Conditions, General Requirements, and other Division-1 Specification Sections, apply to this Section.

ARTICLE 2: SUMMARY

- 2.1 This Section specifies administrative and procedural requirements for Unit Prices.
 - .1 A Unit Price is an amount proposed by Bidders and stated on the Bid Form as a price per unit of measurement for materials or services that will be added to, or deducted from, the Contract Sum by Change Order in the event the estimated quantities of Work required by the Contract Documents are increased or decreased.
 - .2 Unit Prices include all necessary material, labor, overhead, profit and applicable taxes.
 - .3 Refer to individual Specification Sections for construction activities requiring the establishment of Unit Prices. Methods of measurement and payment for Unit Prices are specified herein.
 - .4 Contingent Bid Unit Prices shall be exercised only after receiving written direction from the owner, or owners representative, at the unit price identified on the approved bid form.
- 2.2 Schedule: A "Unit Price Schedule" is included at the end of this Section. Specification Sections in the Project Manual contain requirements for materials and methods necessary to achieve the Work described under each Unit Price.
 - .1 The Owner reserves the right to reject the Contractor's measurement of work-in-place that involves use of established Unit Prices, and to have this Work measured by an independent surveyor acceptable to the Contractor at the Owner's expense.

ARTICLE 3: UNIT PRICE SCHEDULE

UNIT PRICE No. 1: Mobilization & Demobilization

Description: The work consists of the mobilization and demobilization of the Contractor's forces and equipment necessary for performing the work required.

Unit of Measure: LUMP SUM

Measure of Payment: Percent Complete

UNIT PRICE No. 2: Erosion & Sediment Control

Description: The work includes installation, management, maintenance and removal of all erosion and sediment controls required by the Contract documents, Delaware Sediment and Stormwater Regulations, DNREC inspector requirements, Project permit requirements. This work also includes any temporary or permanent sediment and or stormwater management measures along the Trail and at the Trailhead not specifically addressed elsewhere. This work excludes the permeable parking lot at the Trailhead.

Unit of Measure: LUMP SUM

Measure of Payment: Percent Complete

UNIT PRICE No. 3: Field Engineering

Description: Provide field engineering services; establish grades, lines, and levels, by use of recognized engineering survey practices. Complete construction engineering to support construction or satisfaction of professionally approved submittals.

Unit of Measure: Lump Sum

Measure of Payment: Percent Complete

UNIT PRICE No. 4: Clearing & Grubbing & Removal of Obstructions

Description: Removal of trees, shrubs, roots, rubbish, and other physical objects within the project area as identified in, or as required to complete the work in, the contract documents.

Unit of Measure: Lump Sum

Measure of Payment: Percent Complete

UNIT PRICE No. 5: Bulk Grading

Description: Moving earth to change grades, elevations and or facilitate any aspect of construction of the work outlined in the contract documents.

Unit of Measure: Lump Sum

Measure of Payment: Percent Complete

UNIT PRICE No. 6: Final Grade, Topsoil Seed, Stabilize & Restore

Description: Finish elevation and grade changes, placement of soil and other landscaping materials, restoring disturbed areas to original condition and stabilizing restored areas. This item includes plants to be installed as seed. This item excludes trees and shrubs called in the contract documents and covered under another bid item.

Unit of Measure: Lump Sum

Measure of Payment: Percent Complete

UNIT PRICE No. 7: Offsite Disposal of All Excess Fill / Topsoil

Description: Loading, transport and permanent disposal of all excess topsoil and other soil materials not needed to accomplish the elevations, grades and other design elements depicted in the contract documents.

Unit of Measure: Lump Sum

Measure of Payment: Percent Complete

UNIT PRICE No. 8: 8' Wide Stone Dust Trail

Description: All materials and installation associated with the complete stone dust trail section, in compliance with the contract documents.

Unit of Measure: Square Yard

Measure of Payment: Completed linear feet of stone dust trail.

UNIT PRICE No. 9: Pedestrian Bridge

Description: Pedestrian bridge, support beams, all decking and appurtenances, excavation and grading required to install the bridge and associated bulkheading. This item excludes the helical support piles.

Unit of Measure: Lump Sum

Measure of Payment: Percent Complete

UNIT PRICE No. 10: Helical Pile (Plumb)

Description: Helical support piles, installed plumb, as required by, and installed in compliance with, the contract documents. Unit price shall be honored by the contractor for deviations of stated quantity equal to or less than 40 percent of stated quantity.

Unit of Measure: Linear Foot

Measure of Payment: Linear foot of plumb pile installed.

UNIT PRICE No. 11: Helical Pile (Batter)

Description: Helical support piles, installed as batter piles, as required by, and installed in compliance with, the contract documents. Unit price shall be honored by the contractor for deviations of stated quantity equal to or less than 40 percent of stated quantity.

Unit of Measure: Linear Foot

Measure of Payment: Linear foot of plumb pile installed.

UNIT PRICE No. 12: Concrete Sidewalks & Plaza

Description: Concrete sidewalks, associated curbing, curb ramps and sidewalks at Route 26 and Central Avenue road connections; concrete plaza, sidewalk and curbing at the Town Road Trailhead. This item includes the materials and installation required for a complete sidewalk or plaza section and associated concrete curbing. This item excludes the recessed curbing surrounding the Town Road Trailhead permeable parking lot.

Unit of Measure: Lump Sum

Measure of Payment: Percent Complete

UNIT PRICE No. 13: Trailhead Civil Site Work

Description: Asphalt entrance, stormwater infrastructure, water service, sewer service, electric service, permeable parking lot- complete section, parking lot recessed curbing, utility stub ups,

Unit of Measure: Lump Sum

Measure of Payment: Percent Complete

UNIT PRICE No. 14: Restroom Building (Pre-fabricated)

Description: Pre-fabricated restroom, connection to utility stubs, electric panel, meter and breaker, and options as identified in the contract documents.

Unit of Measure: Lump Sum

Measure of Payment: Percent Complete

UNIT PRICE No. 15: Phase 1 Appurtenances and Misc.

Description: Bicycle racks, bollards, trail and trailhead signage, benches, and fee collection station.

Unit of Measure: Lump Sum

Measure of Payment: Percent Complete

UNIT PRICE No. 16: Town Road Trailhead landscaping

Description: Trees and shrubs as identified in the contract documents.

Unit of Measure: Lump Sum

Measure of Payment: Percent Complete

UNIT PRICE No. 17: ROW and Parking Lot Signage and Striping

Description: All signage and striping required within R.O.W., at road crossings per road crossing plans and within the Town Road Trailhead parking lot.

Unit of Measure: Lump Sum

Measure of Payment: Percent Complete

CONTINGENT BID ITEM - UNIT PRICE No. 18: Buffer Plantings (Shade)

Description: Shade buffer plantings as described in the contract documents.

Unit of Measure: Linear Foot of planting of width detailed in the contract documents.

Measure of Payment: Linear foot installed in compliance with the contract documents and identified planting width.

CONTINGENT BID ITEM - UNIT PRICE No. 19: Buffer Plantings (Sun)

Description: Sun buffer plantings as described in the contract documents.

Unit of Measure: Linear Foot of planting of width detailed in the contract documents.

Measure of Payment: Linear foot installed in compliance with the contract documents and identified planting width.

CONTINGENT BID ITEM - UNIT PRICE No. 20: Tree Removal (\leq 12 inch caliper)

Description: Removal and offsite disposal of trees less than 12 inches in caliper as measured from 3' above nearest existing grade. Trees shall be identified by arborist in coordination with the owner and owner representatives. Trees shall not be removed without explicit owner approval and direction.

Unit of Measure: Each.

Measure of Payment: Complete tree removal and disposal.

CONTINGENT BID ITEM - UNIT PRICE No. 21: Tree Removal (\geq 12 inch caliper)

Description: Removal and offsite disposal of trees greater than 12 inches in caliper as measured from 3' above nearest existing grade. Trees shall be identified by arborist in coordination with the owner and owner representatives. Trees shall not be removed without explicit owner approval and direction.

Unit of Measure: Each.

Measure of Payment: Complete tree removal and disposal.

END OF SECTION 01026 - UNIT PRICES

SECTION 01040 - PROJECT COORDINATION**TABLE OF ARTICLES**

1. RELATED DOCUMENTS
2. SUMMARY
3. COORDINATION
4. SUBMITTALS
5. GENERAL INSTALLATION PROVISIONS
6. CLEANING AND PROTECTION

ARTICLE 1: RELATED DOCUMENTS

- 1.1 Drawings and general provisions of the Contract, including General Conditions, Supplementary General Conditions, General Requirements, and other Division-1 Specification Sections, apply to this Section

ARTICLE 2: SUMMARY

- 2.1 This Section specifies administrative and supervisory requirements necessary for Project Coordination including, but not necessarily limited to:
 - .1 Coordination.
 - .2 Administrative and Supervisory Personnel.
 - .3 General Installation Provisions.
 - .4 Cleaning and Protection.
- 2.2 Field engineering is included in Section "Field Engineering".
- 2.3. Progress meetings, coordination meetings and pre-installation conferences are included in Section "Project Meetings".
- 2.4. Requirements for the Contractor's Construction Schedule are included in Section "Submittals".

ARTICLE 3: COORDINATION

- 3.1 Coordination: Coordinate construction activities included under various Sections of these Specifications to assure efficient and orderly installation of each part of the Work. Coordinate construction operations included under different Sections of the Specifications that are dependent upon each other for proper installation, connection, and operation.
 - .1 Where installation of one part of the Work is dependent on installation of other components, either before or after its own installation, schedule construction activities in the sequence required to obtain the best results.
 - .2 Where availability of space is limited, coordinate installation of different components to assure maximum accessibility for required maintenance, service and repair.
 - .3 Make adequate provisions to accommodate items scheduled for later installation.
- 3.2 Where necessary, prepare memoranda for distribution to each party involved outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings.

- .1 Prepare similar memoranda for the Owner and separate Contractors where coordination of their Work is required.
- 3.3 Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 - .1 Preparation of schedules.
 - .2 Installation and removal of temporary facilities.
 - .3 Delivery and processing of submittals.
 - .4 Progress meetings.
 - .5 Project Close-out activities.
- 3.4 Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.
 - .1 Salvage materials and equipment involved in performance of, but not actually incorporated in, the Work. Refer to other sections for disposition of salvaged materials that are designated as Owner's property.

ARTICLE 4: SUBMITTALS

- 4.1 Staff Names: Within 15 days of Notice to Proceed, submit a list of the Contractor's principal staff assignments, including the Superintendent and other personnel in attendance at the site; identify individuals, their duties and responsibilities; list their addresses and telephone numbers.

ARTICLE 5: GENERAL INSTALLATION PROVISIONS

- 5.1 Inspection of Conditions: Require the Installer of each major component to inspect both the substrate and conditions under which Work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.
- 5.2 Manufacturer's Instructions: Comply with manufacturer's installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.
- 5.3 Inspect materials or equipment immediately upon delivery and again prior to installation. Reject damaged and defective items.
- 5.4 Provide attachment and connection devices and methods necessary for securing Work. Secure Work true to line and level. Allow for expansion and building movement.
- 5.5 Visual Effects: Provide uniform joint widths in exposed Work. Arrange joints in exposed Work to obtain the best visual effect. Refer questionable choices to the Architect for final decision.
- 5.6 Recheck measurements and dimensions, before starting each installation.
- 5.7 Install each component during weather conditions and Project status that will ensure the best possible results. Isolate each part of the completed construction from incompatible material as necessary to prevent deterioration.
- 5.8 Coordinate temporary enclosures with required inspections and tests, to minimize the necessity of uncovering completed construction for that purpose.
- 5.9 Mounting Heights: Where mounting heights are not indicated, install individual components at standard mounting heights recognized within the industry for the particular application indicated.

Refer questionable mounting height decisions to the Architect for final decision.

ARTICLE 6: CLEANING AND PROTECTION

- 6.1 During handling and installation, clean and protect construction in progress and adjoining materials in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- 6.2 Clean and maintain completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- 6.3 Limiting Exposures: Supervise construction activities to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Where applicable, such exposures include, but are not limited to, the following:
 - .1 Excessive static or dynamic loading.
 - .2 Excessive internal or external pressures.
 - .3 Excessively high or low temperatures.
 - .4 Thermal shock.
 - .5 Excessively high or low humidity.
 - .6 Air contamination or pollution.
 - .7 Water or ice.
 - .8 Solvents.
 - .9 Chemicals.
 - .10 Light.
 - .11 Radiation.
 - .12 Puncture.
 - .13 Abrasion.
 - .14 Heavy traffic.
 - .15 Soiling, staining and corrosion.
 - .16 Bacteria.
 - .17 Rodent and insect infestation.
 - .18 Combustion.
 - .19 Electrical current.
 - .20 High speed operation.
 - .21 Improper lubrication.
 - .22 Unusual wear or other misuse.
 - .23 Contact between incompatible materials.
 - .24 Destructive testing.
 - .25 Misalignment.
 - .26 Excessive weathering.
 - .27 Unprotected storage.
 - .28 Improper shipping or handling.
 - .29 Theft.
 - .30 Vandalism.
 - .31 Wind damage.

END OF SECTION 01040 - PROJECT COORDINATION

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SECTION 01050 - FIELD ENGINEERING**TABLE OF ARTICLES**

1. RELATED DOCUMENTS
2. SUMMARY
3. SUBMITTALS
4. QUALITY ASSURANCE
5. EXAMINATION
6. PERFORMANCE

ARTICLE 1: RELATED DOCUMENTS

- 1.1 Drawings and general provisions of the Contract, including General Conditions, Supplementary General Conditions, General Requirements, and other Division-1 Specification Sections, apply to this Section

ARTICLE 2: SUMMARY

- 2.1 General: This Section specifies administrative and procedural requirements for Field Engineering services, including, but not necessarily limited to, the following:
 - 2.1 Land Survey Work
 - 2.2 Engineering Services

ARTICLE 3: SUBMITTALS

- 3.1 Certificates: Submit a certificate signed by the Land Surveyor certifying that the location and elevation of improvements comply with the Contract Documents.
- 3.2 Project Record Documents: Submit a record of Work performed and record survey data as required under provisions of Sections "Submittals" and "Project Closeout".

ARTICLE 4: QUALITY ASSURANCE

- 4.1 Surveyor: Engage a Professional Land Surveyor, licensed in the State of Delaware, to perform required surveying services to ensure that grades, lines, levels, and locations of the Work are in compliance with the Contract Documents.
- 4.2 Engineer: Engage a Professional Engineer of the discipline required, registered in the State of Delaware, to perform required engineering services.

ARTICLE 5: EXAMINATION

- 5.1 The Owner will identify existing control points and property line corner stakes.
- 5.2 Verify layout information shown on the Drawings, in relation to the property survey and existing benchmarks before proceeding to layout the Work. Locate and protect existing benchmarks and control points. Preserve permanent reference points during construction.
 - .1 Do not change or relocate benchmarks or control points without prior written approval. Promptly report lost or destroyed reference points, or requirements to relocate reference points because of necessary changes in grades or locations.

- .2 Promptly replace lost or destroyed Project control points. Base replacements on the original survey control points.
- 5.3 Establish and maintain a minimum of two permanent benchmarks on the site, referenced to data established by survey control points.
 - .1 Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
- 5.4 Existing utilities and equipment: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction.

ARTICLE 6: PERFORMANCE

- 6.1 Working from lines and levels established by the property survey, establish benchmarks and markers to set lines and levels at each story of construction and elsewhere as needed to properly locate each element of the Project. Calculate and measure required dimensions within indicated or recognized tolerances. Do not scale Drawings to determine dimensions.
 - .1 Advise entities engaged in construction activities, of marked lines and levels provided for their use.
 - .2 As construction proceeds, check every major element for line, level and plumb.
- 6.2 Surveyor's Log: Maintain a surveyor's log of control and other survey Work. Make this log available for reference.
 - .1 Record deviations from required lines and levels, and advise the Architect when deviations that exceed indicated or recognized tolerances are detected. On Project Record Drawings, record deviations that are accepted and not corrected.
 - .2 On completion of foundation walls, major site improvements, and other Work requiring field engineering services, prepare a certified survey showing dimensions, locations, angles and elevations of construction and sitework.
- 6.3 Site Improvements: Locate and lay out site improvements, including pavements, stakes for grading, fill and topsoil placement, utility slopes and invert elevations by instrumentation and similar appropriate means.
- 6.4 Building Lines and Levels: Locate and lay out batter boards for structures, building foundations, column grids and locations, floor levels and control lines and levels required for mechanical and electrical work.

END OF SECTION 01050 - FIELD ENGINEERING

SECTION 01090 - DEFINITIONS AND STANDARDS

TABLE OF ARTICLES

1. DEFINITIONS
2. SPECIFICATION FORMAT AND CONTENT EXPLANATION
3. DRAWING OF SYMBOLS
4. INDUSTRY STANDARDS

ARTICLE 1: DEFINITIONS:

- 1.1 Basic Contract definitions are included in the General Conditions, Supplementary General Conditions, General Requirements, and Instructions to Bidders.
- 1.2 INDICATED refers to graphic representations, notes or schedules on Drawings, or Paragraphs or Schedules in Specifications, and similar requirements in Contract Documents. Where terms such as "shown", "noted", "scheduled", and "specified" are used, it is to help locate the reference.
- 1.3 DIRECTED: Terms such as "directed", "requested", "authorized", "selected", "approved", "required", and "permitted" mean "directed by the Engineer", "requested by the Engineer", and similar phrases. No implied meaning shall be interpreted to extend the Owner's Representative's responsibility into the Contractor's supervision of construction.
- 1.4 APPROVE, used in conjunction with action on submittals, applications, and requests, is limited to the Owner's Representative's duties and responsibilities stated in General Conditions and Supplementary General Conditions. Approval shall not release the Contractor from responsibility to fulfill Contract requirements.
- 1.5 REGULATION includes laws, ordinances, statutes and lawful orders issued by authorities having jurisdiction, and rules, conventions and agreements within the construction industry that control performance of the Work, whether lawfully imposed by authorities having jurisdiction or not.
- 1.6 FURNISH means "supply and deliver, ready for unloading, unpacking, assembly, installation, and similar operations."
- 1.7 INSTALL describes operations at the site including "unloading, unpacking, assembly, erection, anchoring, applying, working to dimension, protecting, cleaning and similar operations."
- 1.8 PROVIDE means "furnish and install, complete and ready for use."
- 1.9 INSTALLER: "Installer" is the Contractor or an entity engaged by the Contractor, as an employee, subcontractor or sub-subcontractor for performance of a particular construction activity, including installation, erection, application and similar operations. Installers are required to be experienced in the operations they are engaged to perform.
 - .1 The term "experienced", when used with "Installer" means having a minimum of 5 previous projects similar in size to this Project, and familiar with the precautions required, and with requirements of the authority having jurisdiction.
- 1.10 PROJECT SITE is the space available for construction activities, either exclusively or with others performing other construction on the Project. The extent of the Project Site shall be as directed by the Owner's Representative, and may or may not be identical with the description of the land upon which the Project is to be built.

- 1.11 TESTING LABORATORIES: A "testing laboratory" is an independent entity engaged to perform specific inspections or tests, at the Project Site or elsewhere, and to report on, and, if required, to interpret results of those inspections or tests.
- 1.12 WORKING DAY: Any calendar day, except: 1) Saturdays, Sundays, and holidays; 2) days where conditions identified in the Contract require the Contractor to suspend construction operations; 3) days with inclement weather that prevents prosecution of the scheduled work. On inclement weather days that result in partial prosecution of the work, partial working days will be charged as determined by the Engineer. Partial working days will be charged in one-quarter day increments. If the Contractor receives permission from the Engineer to work on a Sunday or holiday, full working days will be charged, weather permitting. No time charge will be assessed if the Contractor elects to work on Saturdays. Should the Contractor prepare to begin work on any day on which inclement weather prevents the work from beginning at the usual starting time and the crew is dismissed as a result, the Contractor will not be charged for a working day whether or not conditions change during the day and the rest of the day becomes suitable for construction operations.

ARTICLE 2: SPECIFICATION FORMAT AND CONTENT EXPLANATION

- 2.1 SPECIFICATION FORMAT: These specifications are organized into Divisions and Sections based on the Construction Specifications Institute's 16-Division format and MASTER FORMAT numbering system.
- 2.2 Language used in the Specifications is the abbreviated type. Implied words and meanings will be appropriately interpreted. Singular words will be interpreted as plural and plural words interpreted as singular where applicable and where the context so indicates.
- .1 IMPERATIVE LANGUAGE is used generally. Requirements expressed in the imperative mood are to be performed by the Contractor. At certain locations in the text subjective language is used to describe responsibilities which must be fulfilled indirectly by the Contractor, or by others when so noted.
- .2 The words "shall be" shall be included by inference wherever a colon (:) is used within a sentence or phrase.
- 2.3 ASSIGNMENT OF SPECIALISTS: Certain construction activities shall be performed by specialists, recognized experts in the operations to be performed. Specialists must be engaged for those activities, and assignments are requirements over which the Contractor has no option. Nevertheless, the ultimate responsibility for fulfilling Contract requirements remains with the Contractor.

ARTICLE 3: DRAWING OF SYMBOLS

- 3.1 GENERAL: Where not otherwise noted, symbols are defined by "Architectural Graphic Standards", published by John Wiley & Sons, Inc., ninth edition.
- 3.2 MECHANICAL/ELECTRICAL DRAWINGS: Graphic symbols on mechanical and electrical Drawings are aligned with symbols recommended by ASHRAE. Where appropriate, they are supplemented by symbols recommended by technical associations. Refer instances of uncertainty to the Engineer for clarification before proceeding.

ARTICLE 4: INDUSTRY STANDARDS

- 4.1 APPLICABILITY OF STANDARDS: Except where the Contract Documents include more stringent requirements, applicable industry standards have the same force and effect as if bound

or copied into Contract Documents. Such standards are part of the Contract Documents by reference. Individual Sections indicate standards the Contractor must keep available at the Project Site.

- 4.2 PUBLICATION DATES: Where the date of issue of a referenced standard is not specified, comply with the standard in effect as of date of Contract Documents.
- .1 UPDATED STANDARDS: Submit a Change Order proposal where an applicable standard has been revised and reissued after the date of the Contract Documents and before performance of Work. The Engineer will decide whether to issue a Change Order to proceed with the updated standard.
- 4.3 CONFLICTING REQUIREMENTS: Where compliance with two or more standards that establish different or conflicting requirements for minimum quantities or quality levels, the most stringent requirement will be enforced. Refer uncertainties as to which quality level is more stringent to the Engineer for a decision before proceeding.
- .1 MINIMUM QUANTITIES OR QUALITY LEVELS: The quantity or quality shown or specified is the minimum to be provided or performed. Indicated values are minimum or maximum values, as appropriate for the requirements. Refer instances of uncertainty to the Engineer for decision before proceeding.
- 4.4 COPIES OF STANDARDS: Each entity engaged on the Project shall be familiar with standards applicable to that activity. Copies of applicable standards are not bound with the Contract Documents.
- .1 Where copies of standards are needed for performance of a required construction activity, the Contractor shall obtain copies directly from the publication source.
- .2 Although copies of standards needed for enforcement of requirements may be part of submittals, the Owner's Representative reserves the right to require submittal of additional copies for enforcement of requirements.
- 4.5 ABBREVIATIONS AND NAMES: Where acronyms or abbreviations are used in the Specifications or other Contract Documents they mean the recognized name of the trade association, standards generating organization, authority having jurisdiction or other entity applicable. Refer to the "Encyclopedia of Associations", published by Gale, available in most libraries.
- 4.6 PERMITS, LICENSES, AND CERTIFICATES: For the Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, and similar documents, correspondence and records established in conjunction with compliance with standards and regulations bearing upon performance of the Work.

END OF SECTION 01090 - DEFINITIONS AND STANDARDS

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SECTION 01200 - PROJECT MEETINGS**TABLE OF ARTICLES**

1. RELATED DOCUMENTS
2. SUMMARY
3. PRE-CONSTRUCTION CONFERENCE
4. PRE-INSTALLATION CONFERENCES
5. COORDINATION MEETINGS
6. PROGRESS MEETINGS

ARTICLE 1: RELATED DOCUMENTS

- 1.1 Drawings and general provisions of the Contract, including General Conditions, Supplementary General Conditions, General Requirements, and other Division-1 Specification Sections, apply to this Section.

ARTICLE 2: SUMMARY

- 2.1 This Section specifies administrative and procedural requirements for Project Meetings including but not limited to:
 - .1 Pre-Construction Conference.
 - .2 Pre-Installation Conferences.
 - .3 Coordination Meetings.
 - .4 Progress Meetings.
- 2.2 Construction schedules are specified in another Division-1 Section.

ARTICLE 3: PRE-CONSTRUCTION CONFERENCE

- 3.1 Schedule a pre-construction conference and organizational meeting at the Project Site or other convenient location no later than 15 days after execution of the Agreement and prior to commencement of construction activities. Conduct the meeting to review responsibilities and personnel assignments.
- 3.2 Attendees: The Owner, Engineer and their consultants, the Contractor and their superintendent, major subcontractors, manufacturers, suppliers and other concerned parties shall each be represented at the conference by persons familiar with and authorized to conclude matters relating to the Work.
- 3.3 Agenda: Discuss items of significance that could affect progress including such topics as:
 - .1 Tentative construction schedule.
 - .2 Critical work sequencing.
 - .3 Designation of responsible personnel.
 - .4 Procedures for processing field decisions and Change Orders.
 - .5 Procedures for processing Applications for Payment.
 - .6 Distribution of Contract Documents.
 - .7 Submittal of Shop Drawings, Product Data and Samples.
 - .8 Preparation of record documents.
 - .9 Use of the premises.
 - .10 Parking availability
 - .11 Office, work and storage areas.
 - .12 Equipment deliveries and priorities.

- .13 Safety procedures.
- .14 First aid.
- .15 Security.
- .16 Housekeeping.
- .17 Working hours.

ARTICLE 4: PRE-INSTALLATION CONFERENCES

- 4.1 Conduct a pre-installation conference at the site before each construction activity that requires coordination with other construction. The Installer and representatives of manufacturers and fabricators involved in or affected by the installation, and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise the Engineer of scheduled meeting dates.
- .1 Review the progress of other construction activities and preparations for the particular activity under consideration at each pre-installation conference, including requirements for:
- .1 Contract Documents.
 - .2 Options.
 - .3 Related Change Orders.
 - .4 Purchases
 - .5 Deliveries.
 - .6 Shop Drawings, Product Data and quality control Samples.
 - .7 Review of mockups
 - .8 Possible conflicts.
 - .9 Compatibility problems.
 - .10 Time schedules.
 - .11 Weather limitations.
 - .12 Manufacturer's recommendations.
 - .13 Warranty requirements.
 - .14 Compatibility of materials.
 - .15 Acceptability of substrates.
 - .16 Temporary facilities.
 - .17 Space and access limitations.
 - .18 Governing regulations.
 - .19 Safety.
 - .20 Inspection and testing requirements.
 - .21 Required performance results.
 - .22 Recording requirements.
 - .23 Protection.
- 4.2 Record significant discussions and agreements and disagreements of each conference, along with the approved schedule. Distribute the record of the meeting to everyone concerned, promptly, including the Owner and Engineer.
- 4.3 Do not proceed if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of Work and reconvene the conference at the earliest feasible date.

ARTICLE 5: COORDINATION MEETINGS

- 5.1 Conduct Project coordination meetings at regularly scheduled times convenient for all parties involved. Project coordination meetings are in addition to specific meetings held for other purposes, such as regular progress meetings and special pre-installation meetings.

- 5.2 Request representation at each meeting by every party currently involved in coordination or planning for the construction activities involved.
- 5.3 Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

ARTICLE 6: PROGRESS MEETINGS

- 6.1 Conduct progress meetings at the Project Site at regularly scheduled intervals. Notify the Owner and Engineer of scheduled meeting dates. Coordinate dates of meetings with preparation of the payment request.
- 6.2 Attendees: In addition to representatives of the Owner and Engineer, each subcontractor, supplier or other entity concerned with current progress or involved in planning, coordination or performance of future activities shall be represented at these meetings by persons familiar with the Project and authorized to conclude matters relating to progress.
- 6.3 Agenda: Review and correct or approve minutes of the previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to the current status of the Project.
 - .1 Contractor's Construction Schedule: Review progress since the last meeting. Determine where each activity is in relation to the Contractor's Construction Schedule, whether on time or ahead or behind schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - .2 Review the present and future needs of each entity present, including such items as:
 - .1 Interface requirements.
 - .2 Time.
 - .3 Sequences.
 - .4 Deliveries.
 - .5 Off-site fabrication problems.
 - .6 Access.
 - .7 Site utilization.
 - .8 Temporary facilities and services.
 - .9 Hours of work.
 - .10 Hazards and risks.
 - .11 Housekeeping.
 - .12 Quality and work standards.
 - .13 Change Orders.
 - .14 Documentation of information for payment requests.
 - .15 Submittals and other items affecting progress of work.
- 6.4 Reporting: No later than 5 days after each progress meeting date, the Owner will distribute copies of minutes of the meeting to each party present and to other parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.
 - .1 Schedule Updating: Revise the construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue the revised schedule concurrently with the report of each meeting.

END OF SECTION 01200 - PROJECT MEETINGS

SECTION 01300 - SUBMITTALS**TABLE OF ARTICLES**

1. REQUIREMENTS INCLUDED
2. PROCEDURES
3. CONSTRUCTION PROGRESS SCHEDULES
4. SCHEDULE OF VALUES
5. SHOP DRAWINGS
6. PRODUCT DATA
7. MANUFACTURERS' INSTRUCTIONS
8. SAMPLES
9. FIELD SAMPLES
10. ITEMS TO BE SUBMITTED AT CONTRACT SIGNING
11. COLOR SELECTION
12. SUBMITTAL SCHEDULE

ARTICLE 1: REQUIREMENTS INCLUDED

- 1.1 Procedures.
- 1.2 Construction Progress Schedules.
- 1.3 Schedule of Values.
- 1.4 Shop Drawings.
- 1.5 Product Data.
- 1.6 Samples.
- 1.7 Manufacturers' Instructions.
- 1.8 Manufacturers' Certificates.
- 1.9 Submittal Schedule. (*Delete if not required*)

ARTICLE 2: PROCEDURES

- 2.1 Deliver submittals to Owner at 89 Kings Highway, Dover, Delaware.
- 2.2 Transmit each item under a transmittal. Identify Project, Contractor, subcontractor, major supplier; identify pertinent Drawing sheet and detail number, and Specification section number, as appropriate. Identify deviations from Contract Documents. Provide space for Contractor and Engineer review stamps. Allow 2 weeks for Engineer's initial processing of submittals requiring review and return. Submittals will be returned without action when received indirectly (not through the Contractor).
- 2.3 Submit initial progress schedules and schedule of values in duplicate within fourteen (14) days after award of Contract. After review by Engineer, revise and resubmit as required. Submit revised schedules reflecting changes since previous submittal.
- 2.4 Comply with progress schedule for submittals related to Work progress. Coordinate submittal of related items.
- 2.5 After Engineer's review of submittal, revise and resubmit as required, identifying changes made since previous submittal.
- 2.6 Distribute copies of reviewed submittals to concerned persons. Instruct recipients to promptly report any inability to comply with provisions.
- 2.7 Submit a complete schedule of submittals in duplicate within (20) days after award of Contract.

After review by Engineer, revise and resubmit as required. Submit revised schedules reflecting changes since previous submittal. (*Delete this item if schedule of submittals is not required.*)

ARTICLE 3: CONSTRUCTION PROGRESS SCHEDULES

- 3.1 Submit horizontal bar chart with separate bar for each major trade or operation identifying first work day of each week.

ARTICLE 4: SCHEDULE OF VALUES

- 4.1 Submit typed schedule on AIA Form G703. Contractor's standard form or media-driven printout will be considered on request.
- 4.2 Format: Table of Contents of this Project Manual. Identify each line item with number and title of the major Specification sections.
- 4.3 Include in each line item amount of Allowances specified in Section 01020. For Unit Cost Allowances, give quantities measured from Contract Documents multiplied by the unit cost equal to the total for the item.
- 4.4 Include in each line item a directly proportional amount of Contractor's overhead and profit.
- 4.5 Revise schedule to list Change Orders, for each application for payment.
- 4.6 Revise schedule to include a greater or lesser breakdown of owner identified items upon owner request.

ARTICLE 5: SHOP DRAWINGS

- 5.1 Submit the number of opaque reproduces which Contractor requires, plus four (4) copies which will be retained by Engineer.

ARTICLE 6: PRODUCT DATA

- 6.1 Mark each copy to identify applicable products, models, options, and other data; supplement manufacturers' standard data to provide information unique to the Work. Include manufacturers' installation instructions when required by the Specification Section.
- 6.2 Submit the number of copies which Contractor requires, plus four (4) copies which will be retained by Engineer.

ARTICLE 7: MANUFACTURERS' INSTRUCTIONS

- 7.1 When required in individual Specification Section, submit manufacturer's printed instructions for delivery, storage, assembly, installation, adjusting, and finishing, in quantities specified for product data.

ARTICLE 8: SAMPLES

- 8.1 Submit full range of manufacturers' standard colors, textures, and patterns for Architect's selection. Submit samples for selection of finishes within thirty (30) days after date of Contract.
- 8.2 Submit Samples to illustrate functional characteristics of the Product, with integral parts and attachment devices. Coordinate submittal of different categories for interfacing work.
- 8.3 Include identification of each Sample, giving full information.

- 8.4 Submit the number specified in respective Specification Section; one will be retained by Engineer. Reviewed Samples which may be used in the Work are indicated in the Specification Section.

ARTICLE 9: FIELD SAMPLES

- 9.1 Provide field samples of finishes at Project as required by individual Specifications Section. Install sample complete and finished. Acceptable samples in place may be retained in completed Work.

ARTICLE 10: ITEMS TO BE SUBMITTED AT CONTRACT SIGNING

- 10.1 Performance and Labor and Material Payment Bonds: One (1) copy of each bond for each copy of the Agreement, submit simultaneously with the signed Agreement.
- 10.2 Policies or Certificates of Insurance: One (1) copy of each policy or certificate for each copy of the Agreement, submit simultaneously with the signed Agreement.

ARTICLE 11: COLOR SELECTION

- 11.1 Submit all items requiring color selection together (at one time) to facilitate color coordination by Architect.

END OF SECTION 01300 - SUBMITTALS

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SECTION 01400 - QUALITY CONTROL**TABLE OF ARTICLES**

1. REQUIREMENTS INCLUDED
2. RELATED REQUIREMENTS
3. QUALITY CONTROL, GENERAL
4. WORKMANSHIP
5. MANUFACTURER'S INSTRUCTIONS
6. MANUFACTURER'S CERTIFICATES
7. MOCK-UPS
8. MANUFACTURER'S FIELD SERVICES
9. TESTING LABORATORY SERVICES

ARTICLE 1: REQUIREMENTS INCLUDED

- 1.1 General Quality Control.
- 1.2 Workmanship.
- 1.3 Manufacturer's Instructions.
- 1.4 Manufacturer's Certificates.
- 1.5 Mock-ups.
- 1.6 Manufacturer's Field Services.
- 1.7 Testing Laboratory Services.

ARTICLE 2: RELATED REQUIREMENTS

- 2.1 Section 00700 - General Conditions and Section 00710 - General Requirements: Inspection and testing required by governing authorities.

ARTICLE 3: QUALITY CONTROL, GENERAL

- 3.1 Maintain quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

ARTICLE 4: WORKMANSHIP

- 4.1 Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
- 4.2 Perform Work by persons qualified to produce workmanship of specified quality.
- 4.3 Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking.

ARTICLE 5: MANUFACTURER'S INSTRUCTIONS

- 5.1 Comply with instructions in full detail, including each step in sequence. Should instructions conflict with Contract Documents, request clarification from Architect before proceeding.

ARTICLE 6: MANUFACTURER'S CERTIFICATES

- 6.1 When required by individual Specifications Section, submit manufacturer's certificate, in duplicate, that products meet or exceed specified requirements.

ARTICLE 7: MOCK-UPS

- 7.1 When required by individual Specifications Section, erect complete, full-scale mockup of assembly at Project Site.

ARTICLE 8: MANUFACTURER'S FIELD SERVICES

- 8.1 When specified in respective Specification Sections, require manufacturer to provide qualified personnel to observe field conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment as applicable, and to make appropriate recommendations.
- 8.2 Representative shall submit written report to Owner listing observations and recommendations.

ARTICLE 9: TESTING LABORATORY SERVICES

- 9.1 Contractor shall employ and pay for services of an Independent Testing Laboratory to perform inspections, tests, and other services required by various Specification Sections.
- 9.2 Services will be performed in accordance with requirements of governing authorities and with specified standards.
- 9.3 Reports will be submitted to Owner in triplicate giving observations and results of tests, indicating compliance or noncompliance with specified standards and with Contract Documents.
- 9.4 Contractor shall cooperate with Testing Laboratory personnel; furnish tools, samples of materials, design mix, equipment, storage and assistance as requested.
- .1 Notify Owner and Testing Laboratory 24 hours prior to expected time for operations requiring testing services.
- .2 Make arrangements with Testing Laboratory and pay for additional samples and tests for Contractor's convenience.
- 9.5 Any item found unsatisfactory by the testing agency shall be removed, replaced and retested at no additional cost to the Owner.

END OF SECTION 01400 - QUALITY CONTROL

SECTION 01500 - CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS**TABLE OF ARTICLES**

1. GENERAL PROVISIONS
2. REQUIREMENTS INCLUDED
3. GENERAL
4. MATERIALS
5. TEMPORARY ELECTRICITY AND LIGHTING
6. TEMPORARY TELEPHONE SERVICE
7. TEMPORARY WATER
8. TEMPORARY SANITARY FACILITIES
9. CONSTRUCTION AIDS
10. BARRIERS
11. HEAT, VENTILATION
12. ENCLOSURES
13. PROTECTION OF INSTALLED WORK
14. WATER CONTROL
15. CLEANING DURING CONSTRUCTION
16. PROJECT IDENTIFICATION
17. FIELD OFFICES AND SHEDS
18. REMOVAL OF CONSTRUCTION FACILITIES AND RESTORATION OF SITE
19. SECURITY
20. ACCESS ROADS AND PARKING AREAS
21. TEMPORARY CONTROLS
22. TRAFFIC REGULATION

ARTICLE 1: GENERAL PROVISIONS

- 1.1 The general provisions of the Contract, including the conditions of the Contract (General Conditions, Supplementary General Conditions, General Requirements, and other Conditions, if any) and Division 1 as appropriate, apply to the Work specified in this Section.

ARTICLE 2: REQUIREMENTS INCLUDED

- 2.1 Temporary Electricity and Lighting
- 2.2 Temporary Telephone Service
- 2.3 Temporary Water
- 2.4 Temporary Sanitary Facilities
- 2.5 Construction Aids
- 2.6 Barriers
- 2.7 Temporary Heat and Ventilation
- 2.8 Temporary Enclosures
- 2.9 Protection of Installed Work
- 2.10 Water Control
- 2.11 Cleaning During Construction
- 2.12 Project Identification
- 2.13 Field Offices and Sheds
- 2.14 Removal of Construction Facilities and Restoration of Site
- 2.15 Security
- 2.16 Access Roads and Parking Areas
- 2.17 Temporary Controls
- 2.18 Traffic Regulation

ARTICLE 3: GENERAL

- 3.1 Comply with National Electric Code.
- 3.2 Comply with Federal, State and local codes and regulations and with utility company requirements.
- 3.3 Coordinate Work with Owner's requirements.

ARTICLE 4: MATERIALS

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

ARTICLE 5: TEMPORARY ELECTRICITY AND LIGHTING

- 5.1 Provide temporary electric power and power distribution system as needed to perform the Work.

ARTICLE 6: TEMPORARY TELEPHONE SERVICE

- 6.1 Provide telephone service as necessary to properly conduct the Work and to comply with applicable regulations.
- 6.2 At each telephone, post a list of important telephone numbers.

ARTICLE 7: TEMPORARY WATER

- 7.1 Provide potable water for drinking and construction purposes.
- 7.2 The Contractor shall make all necessary arrangements for temporary water service for construction purposes, and furnish at his own expense all piping and accessories required.
- 7.3 Take positive measures to preclude cross-connections and backflow.
- 7.4 The Contractor will assume the cost of water consumed if responsible care and restraint are not exercised by the Contractor in its use.

ARTICLE 8: TEMPORARY SANITARY FACILITIES

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

ARTICLE 9: CONSTRUCTION AIDS

- 9.1 Each Subcontractor shall provide construction aids and equipment required by his personnel and to facilitate execution of his Work. Examples are scaffolds, staging, ladders, stairs, ramps, runways, platforms, railings, hoists, cranes, chutes and other such facilities and equipment.
- 9.2 Mutual use may be arranged by the Contractor where applicable.

ARTICLE 10: BARRIERS

- 10.1 Materials at Contractor's option, as appropriate to serve required purpose.

ARTICLE 11: HEAT, VENTILATION

(Not Used)

ARTICLE 12: ENCLOSURES

(Not Used)

ARTICLE 13: PROTECTION OF INSTALLED WORK

- 13.1 Provide temporary protection for installed products. Control traffic in immediate area to minimize damage.
- 13.2 Prohibit traffic and storage on waterproofed and roofed surfaces, on lawn and landscaped areas.

ARTICLE 14: WATER CONTROL

- 14.1 Maintain excavations free of water. Provide and operate pumping equipment. Grade site to drain.

ARTICLE 15: CLEANING DURING CONSTRUCTION

- 15.1 Control accumulation of waste materials and rubbish; periodically dispose of legally off site.
- 15.2 Clean interior areas prior to start of finish work, maintain areas free of dust and other contaminants during finishing operations.

ARTICLE 16: PROJECT IDENTIFICATION

(Not Used)

ARTICLE 17: FIELD OFFICES AND SHEDS

- 17.1 Field offices and sheds are to be provided by the Contractor as necessary to properly conduct the Work. A field office is not required by the owner for associated project activities such as progress meetings, maintaining as-built drawings, and storage of materials.

ARTICLE 18: REMOVAL OF CONSTRUCTION FACILITIES AND RESTORATION OF SITE

- 18.1 Remove temporary materials, equipment, services, and construction prior to Substantial Completion Inspection.
- 18.2 Clean and repair damage caused by installation or use of temporary facilities. Remove underground installations to a depth of two (2) feet; grade site as indicated.

ARTICLE 19: SECURITY

- 19.1 Security of persons and property in areas under control of the Contractor shall be the Contractor's exclusive responsibility.
- 19.2 The Contractor, at this own expense, shall initiate whatever programs that are necessary to execute his responsibility.
- 19.3 Control of access to the areas under his control shall be maintained. Visitors shall be required to report immediately to the Contractor's Superintendent and to produce full identification which will be recorded in the Contractor's Daily Log, along with the purpose of the visit.

ARTICLE 20: ACCESS ROADS AND PARKING AREAS

- 20.1 Provide and maintain uninterrupted vehicular access to site and within it:
- .1 To temporary construction facilities, storage and work areas.
 - .2 For use by persons and equipment involved in construction of project.
- 20.2 Maintain traffic areas free as possible of excavated materials, construction equipment, products, snow, ice and debris.
- 20.3 Keep fire hydrants and water control valves free from obstruction and accessible for use.
- 20.4 Designated areas of existing parking facilities may be used for parking of construction personnel's private vehicles and of Contractor's light-weight vehicles.

ARTICLE 21: TEMPORARY CONTROLS

- 21.1 Provide the following Temporary Controls:
- .1 Control of noise.
 - .2 Control of dust, both on site and within building.
 - .3 Control of surface water to prevent damage to the project, the site or adjacent properties.
 - .4 Control of pests and rodents to prevent infestation of construction or storage areas.
 - .5 Control of debris.
 - .6 Control of pollution of soil, water or atmosphere in accordance with applicable laws.
 - .7 Control of erosion in accordance with applicable laws.
 - .8 Control of mud and snow, including removal where necessary to construction operations.
Remove any mud tracked from site onto public roads or streets.
 - .9 Visually shield parcels adjacent to material stockyard on Osprey Lane.

ARTICLE 22: TRAFFIC REGULATION

- 22.1 Obtain all temporary permits for access to, and use of public roads and streets for construction and hauling purposes. Comply with traffic control regulations applying to permit issuance.
- 22.2 Provide all markers, signs, lights and barriers on, and near the site to safely control construction traffic and public access.

END OF SECTION 01500 – CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

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SECTION 01600 - MATERIALS AND EQUIPMENT**TABLE OF ARTICLES**

1. GENERAL CONDITIONS
2. REQUIREMENTS INCLUDED
3. MANUFACTURER'S INSTRUCTIONS
4. TRANSPORTATION AND HANDLING
5. STORAGE AND PROTECTION
6. SUBSTITUTIONS AND PRODUCT OPTIONS

ARTICLE 1: GENERAL CONDITIONS

- 1.1 The general provisions of the Contract, including the conditions of the Contract (General Conditions, Supplementary General Conditions, General Requirements, and other Conditions, if any) and Division 1 as appropriate, apply to the Work specified in this Section.
- 1.2 Where Work is to be executed under Separate Prime Contracts, the provisions of this Section apply to each contract.

ARTICLE 2: REQUIREMENTS INCLUDED

- 2.1 All material and equipment incorporated into the Work shall:
 - .1 Conform to applicable specifications and standards.
 - .2 Comply with size, make, type and quality specified, or as specifically approved in writing by the Architect.
- 2.2 Manufactured and Fabricated Products shall conform to the following requirements:
 - .1 Design, fabricate and assemble in accordance with the best engineering and shop practices.
 - .2 Manufacture like parts of duplicate units to standard sizes and gauges, to be interchangeable.
 - .3 Two or more items of the same kind shall be identical, by the same manufacturer.
 - .4 Products shall be suitable for service conditions.
 - .5 Equipment capacities, sizes and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing.
- 2.3 Do not use material or equipment for any purpose other than that for which it is designated or is specified.
- 2.4 Materials removed from existing structures shall not be re-used in the completed Work unless specifically indicated or specified.
- 2.5 For material and equipment specifically indicated or specified to be re-used in the Work:
 - .1 Use special care in removal, handling, storage and reinstallation, to assure proper function in the completed Work.

- .2 Arrange for transportation, storage and handling of products which require off-site storage, restoration or renovation. Pay all costs for such work.

ARTICLE 3: MANUFACTURER'S INSTRUCTIONS

- 3.1 When Contract Documents require that installation of Work shall comply with manufacturer's printed instructions, obtain and distribute copies of such instructions to parties involved in the installation, including two copies to Engineer.
 - .1 Maintain one set of complete instructions at the job site during installation and until completion.
- 3.2 Handle, install, connect, clean, condition and adjust products in strict accord with such instructions and in conformity with specified requirements.
 - .1 Should job conditions or specified requirements conflict with manufacturer's instructions, consult with Architect for further instructions.
 - .2 Do not proceed with Work without clear instructions.
- 3.3 Perform Work in accord with manufacturer's instructions. Do not omit any preparatory step or installation procedure unless specifically modified or exempted by Contract Documents.

ARTICLE 4: TRANSPORTATION AND HANDLING

- 4.1 Arrange deliveries of products in accord with construction schedules, coordinate to avoid conflict with Work and conditions at the site.
 - .1 Deliver products in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.
 - .2 Immediately on delivery, inspect shipments to assure compliance with requirements of Contract Documents and approved submittals, and that products are properly protected and undamaged.
- 4.2 Provide equipment and personnel to handle products by methods to prevent soiling or damage to products or packaging.

ARTICLE 5: STORAGE AND PROTECTION

- 5.1 Store products in accord with manufacturer's instructions, with seals and labels intact and legible.
 - .1 Store products subject to damage by the elements in weather-tight enclosures.
 - .2 Maintain temperature and humidity within the ranges required by manufacturer's instructions.
- 5.2 Exterior Storage.
 - .1 Store fabricated products above the ground, on blocking or skids, prevent soiling or staining. Cover products which are subject to deterioration with impervious sheet coverings; provide adequate ventilation to avoid condensation.
 - .2 Store loose granular materials in a well-drained area on solid surfaces to prevent mixing

with foreign matter.

- 5.3 Arrange storage in a manner to provide easy access for inspection. Make periodic inspection of stored products to assure that products are maintained under specified conditions, and free from damage or deterioration.
- 5.4 Store flammable materials so as to prevent contact with flames and fire. Conform with manufacturer's recommendations and local laws. Pay particular attention to storage of:
 - .1 Paint materials.
 - .2 Cleaning and other solvents.
 - .3 Fuels.
- 5.5 Protection After Installation:
 - .1 Provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations. Remove when no longer needed.

ARTICLE 6: SUBSTITUTIONS AND PRODUCT OPTIONS

- 6.1 Product List.
 - .1 Within 14 days after date of Owner-Contractor Agreement, submit a complete list of major products proposed for use, with the name of the manufacturer, trade name, and model number of each product and the installing subcontractor.
- 6.2 Contractor's Options.
 - .1 For products specified only by reference standard, select any product meeting that standard.
 - .2 For products specified by naming several products or manufacturers, select any one of the products or manufacturers named which complies with the specifications.
 - .3 For products specified by naming one or more products or manufacturers and "or equal", bidders must, during the bidding period, submit a request for substitutions for any product or manufacturer not specifically named. See provisions in Article 6, paragraph 6.3.
 - .4 For products specified by naming only one product and manufacturer, there is no option.
- 6.3 Substitutions.
 - .1 Requests for substitutions shall be made in writing and received by the Owner before 4:30 p.m., 10 calendar days prior to bid opening. Subsequently, substitutions will be considered only when a Product becomes unavailable due to no fault of the Contractor. The Architect will review requests and will notify bidders in an Addendum if the requested substitution is acceptable.
 - .2 Submit a separate request for each product, supported with complete data, with drawings and samples as appropriate, including:
 - .1 Comparison of the qualities of the proposed substitution with that specified.
 - .2 Changes required in other elements of the work because of the substitution.
 - .3 Effect on the construction schedule.
 - .4 Cost data comparing the proposed substitution with the product specified.
 - .5 Any required license fees or royalties.

- .6 Availability of maintenance service, and source of replacement materials.
- .3 Engineer shall be the judge of the acceptability of the proposed substitution.
- .4 A request for a substitution constitutes a representation that Bidder:
 - .1 Has investigated the proposed product and determined that it is equal to or superior in all respects to that specified.
 - .2 Will provide the same warranties or bonds for the substitution as for the product specified.
 - .3 Will coordinate the installation of an accepted substitution into the Work, and make such other changes as may be required to make the Work complete in all respects.
 - .4 Waives all claims for additional costs, under his responsibility, which may subsequently become apparent.

END OF SECTION 01600 – MATERIALS AND EQUIPMENT

(Use the Section Only if Applicable)

SECTION 01650 - STARTING OF SYSTEMS

TABLE OF ARTICLES

1. SECTION INCLUDES
2. RELATED SECTIONS
3. STARTING SYSTEMS
4. EQUIPMENT DEMONSTRATION AND OWNER PERSONNEL INSTRUCTION

ARTICLE 1: SECTION INCLUDES

- 1.1 Starting systems.
- 1.2 Demonstration and instructions.

ARTICLE 2: RELATED SECTIONS

- 2.1 Section 01700 - Contract Closeout: System operation and maintenance data and extra materials.

ARTICLE 3: STARTING SYSTEMS

- 3.1 Coordinate schedule for start-up of various equipment and systems.
- 3.2 Notify Architect/Engineer and Owner seven days prior to start-up of each item.
- 3.3 Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or other conditions which may cause damage.
- 3.4 Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- 3.5 Verify wiring and support components for equipment are complete and tested.
- 3.6 Execute start-up under supervision of responsible manufacturer's representative and/or Contractor's personnel in accordance with manufacturer's instructions.
- 3.7 When specified in individual Specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- 3.8 Submit a written report that the equipment or system has been properly installed and is functioning correctly.

ARTICLE 4: EQUIPMENT DEMONSTRATION AND OWNER PERSONNEL INSTRUCTION

- 4.1 Two (2) weeks prior to date of Final Inspection, the Contractor is to provide demonstrations and instructions for all equipment and systems for which operating and maintenance data is required. Notify Architect/Engineer and Owner seven (7) days prior to start-up of each item.
- 4.2 Do not begin demonstrations until the component, assembly or system being demonstrated has been tested as specified and is in satisfactory operating condition. If seasonal limitations

prevent demonstration of certain equipment, these demonstrations and instructions will be postponed to an appropriate time as directed by the Architect.

4.3 Demonstrations and instructions by the Contractor shall include:

- .1 Inspection and satisfactory operation, in presence of Engineer and Owner, of each system and item of equipment, including accessories. Utilize Operation and Maintenance Manuals as basis for instruction.
- .2 Instruction of Owner's personnel in operation and maintenance of equipment and systems. The amount of time required for instruction on each item of equipment and system is that specified in individual sections.
 - .1 Provide all necessary instruction to satisfaction of Owner. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled times at equipment location.
- .3 Explanation of Operating and Maintenance Manuals. Prepare and insert additional data in Operations and Maintenance Manuals when need for additional data becomes apparent during instruction.
- .4 Tour of building areas involved and identify:
 - .1 Maintenance points and access.
 - .2 Control locations and equipment.
- .5 Explanation of operating sequences.
 - .1 Identify location and show operation of switches, valves, etc., used to start, stop and adjust systems.
 - .2 Explain use of flow diagrams, operating sequence diagrams, etc.
 - .3 Demonstrate operation through complete control cycle and full range of operation in all modes, including testing and adjusting relevant to operation.
- .6 Explanation of control equipment, including temperature settings, switch modes, available adjustments, reading of gages, and functions that must be serviced only by authorized factory representatives.
- .7 Explanation of trouble-shooting procedures.
 - .1 Demonstrate commonly occurring problems.
 - .2 Note procedures which must be performed by factory personnel.
- .8 Explanation of maintenance procedures and requirements.
 - .1 Point out items requiring periodic maintenance.
 - .2 Demonstrate typical preventive maintenance procedures and recommended typical maintenance intervals.
 - .3 Demonstrate other commonly occurring maintenance procedures not part of preventive maintenance program.

.4 Identify maintenance materials to be used.

.9 Furnishing all tools required.

4.4 Maintenance Materials and Spare Parts

.1 The Contractor shall furnish to the Owner all maintenance materials, spare parts, tools and "attic supplies," as required by the Specifications, within seven (7) days after the Date of Substantial Completion.

.2 The above items shall be packed in boxes clearly identifying:

.1 The trade name and stock number.

.2 Where item material is to be used.

.3 The name, address and phone number of the closest supplier.

END OF SECTION 01650 - STARTING OF SYSTEMS

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SECTION 01700 - CONTRACT CLOSEOUT

TABLE OF ARTICLES

1. REQUIREMENTS INCLUDED
2. RELATED REQUIREMENTS
3. CLOSEOUT PROCEDURES
4. FINAL CLEANING
5. OPERATION AND MAINTENANCE DATA
6. WARRANTIES AND BONDS
7. SPARE PARTS AND MAINTENANCE MATERIALS

ARTICLE 1: REQUIREMENTS INCLUDED

- 1.1 Closeout Procedures.
- 1.2 Final Cleaning.
- 1.3 Operation and Maintenance Data.
- 1.4 Warranties and Bonds.
- 1.5 Spare Parts and Maintenance Materials.

ARTICLE 2: RELATED REQUIREMENTS

- 2.1 Drawings and general provisions of the Contract, including General Conditions, Supplementary General Conditions, General Requirements, and other Division-1 Specification Sections, apply to this Section.
 - .1 Fiscal provisions, legal submittals, and other administrative requirements.
- 2.2 Section 00600 - Bonds, Certificates and Administrative Forms (AIA Documents), applies to this Section.

ARTICLE 3: CLOSEOUT PROCEDURES

- 3.1 Comply with procedures stated in General Conditions of the Contract for issuance of Certificate of Substantial Completion.
- 3.2 When Contractor considers Work has reached final completion, 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 Owner's inspection.
- 3.3 In addition to submittals required by the conditions of the Contract, provide submittals required by governing authorities, and submit a final statement of accounting giving total adjusted Contract Sum, previous payments, and sum remaining due.
- 3.4 Owner will issue a final Change Order reflecting approved adjustments to Contract Sum not previously made by Change Order.

ARTICLE 4: FINAL CLEANING

- 4.1 Execute prior to final inspection.
- 4.2 Clean interior and exterior surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum soft surfaces. Clean equipment and fixtures to a sanitary condition, clean or replace filters of mechanical equipment.

Clean roofs, gutters, downspouts, and drainage systems.

- 4.3 Clean site: Sweep paved areas, rake clean other surfaces.
- 4.4 Remove waste and surplus materials, rubbish, and construction facilities from the Project and from the Site. Provide final cleaning.

ARTICLE 5: OPERATION AND MAINTENANCE DATA

- 5.1 Provide data for:
 - .1 Mechanical equipment and controls.
 - .2 Electrical equipment and controls.
- 5.2 Submit three (3) sets prior to final inspection, bound in 8-1/2 x 11 inch (216 x 279 mm) three-ring side binders with durable plastic covers.
- 5.3 Provide a separate volume for each system, with a table of contents and index tabs for each volume.
- 5.4 Part 1: Directory, listing names, addresses, and telephone number of: Suppliers and Contractor.
- 5.5 Part 2: Operation and maintenance instructions, arranged by Specification Division. For each Specification give names, addresses, and telephone number of Subcontractors and Suppliers.

List:

- .1 Appropriate design criteria.
- .2 List of equipment.
- .3 Parts list.
- .4 Operating instructions.
- .5 Maintenance instructions, equipment.
- .6 Maintenance instructions, finishes.
- .7 Shop Drawings and Product Data.
- .8 Warranties.

ARTICLE 6: WARRANTIES AND BONDS

- 6.1 Provide duplicate, notarized copies. Execute Contractor's submittals and assemble documents executed by subcontractors, suppliers, and manufacturers. Provide table of contents and assemble in binder with durable plastic cover.
- 6.2 Submit material prior to final application for payment. For equipment put into use with Owner's written permission during construction, submit within seven (7) days after first operation. For items of work delayed materially beyond date of Substantial Completion, provide updated submittal within ten (10) days after acceptance, listing date of acceptance as start of warranty period.

ARTICLE 7: SPARE PARTS AND MAINTENANCE MATERIALS

- 7.1 Provide products, spare parts, and maintenance materials in quantities specified in each Section, in addition to that used for construction of Work. Coordinate with Owner, deliver to Project Site and obtain receipt prior to final payment.

END OF SECTION 01700 - CONTRACT CLOSEOUT

SECTION 01720 - PROJECT RECORD DOCUMENTS**TABLE OF ARTICLES**

1. REQUIREMENTS INCLUDED
2. MAINTENANCE OF DOCUMENTS AND SAMPLES
3. MARKING DEVICES
4. RECORDING
5. SUBMITTAL

ARTICLE 1: REQUIREMENTS INCLUDED

- 1.1 Maintain at the site for the Owner one (1) record copy of:
 - .1 Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Change Orders and other Modifications to the Contract.
 - .5 Engineer Field Orders or Written Instructions.
 - .6 Approved Shop Drawings, Product Data and Samples.
 - .7 Field Test Records.

ARTICLE 2: MAINTENANCE OF DOCUMENTS AND SAMPLES

- 2.1 Store documents and samples in Contractor's field office apart from documents used for construction.
- 2.2 File documents and samples in accordance with CSI format.
- 2.3 Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.
- 2.4 Make documents and samples available at all times for inspection by Owner's representative.

ARTICLE 3: MARKING DEVICES

- 3.1 Provide felt tip marking pens for recording information in the code designated by Owner's representative.

ARTICLE 4: RECORDING

- 4.1 Label each document "PROJECT RECORD" in neat large printed letters.
- 4.2 Record information concurrently with construction progress.
 - .1 Do not conceal any work until required information is recorded.
- 4.3 Drawings: Legibly mark to record actual construction:
 - .1 Depths of various elements of foundation in relation to finish first floor datum.
 - .2 Horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

- .3 Location of internal utilities and appurtenances concealed in the construction, referenced to visible and accessible features of the structure.
 - .4 Field changes of dimension and detail.
 - .5 Changes made by Change Order.
 - .6 Details not on original Contract Drawings.
- 4.4 Specifications and Addenda: Legibly mark each Section to record:
- .1 Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.
 - .2 Changes made by Change Order.

ARTICLE 5: SUBMITTAL

- 5.1 Prior to contract close-out, Contractor shall submit record documents as specified for Owner's review and acceptance, Contractor shall submit a set of reproducible sepias for Owner's use.
- 5.2 Accompany submittal with transmittal letter in duplicate, containing:
- .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Title and number of each record document.
 - .5 Signature of Contractor or his authorized representative.

END OF SECTION 01720 – PROJECT RECORD DOCUMENTS

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes: Administrative and procedural requirements for construction waste management activities.

1.2 DEFINITIONS

- A. Construction, Demolition, and Land clearing (CDL) Waste: Includes all non-hazardous solid wastes resulting from construction, remodeling, alterations, repair, demolition and land clearing. Includes material that is recycled, reused, salvaged or disposed as garbage.
- B. Salvage: Recovery of materials for on-site reuse, sale or donation to a third party.
- C. Reuse: Making use of a material without altering its form. Materials can be reused on-site or reused on other projects off-site. Examples include, but are not limited to the following: Crushing or grinding of concrete for use as sub-base material. Chipping of land clearing debris for use as mulch.
- D. Recycling: The process of sorting, cleaning, treating, and reconstituting materials for the purpose of using the material in the manufacture of a new product.
- E. Source-Separated CDL Recycling: The process of separating recyclable materials in separate containers as they are generated on the job-site. The separated materials are hauled directly to a recycling facility or transfer station.
- F. Co-mingled CDL Recycling: The process of collecting mixed recyclable materials in one container on-site. The container is taken to a material recovery facility where materials are separated for recycling.
- G. Approved Recycling Facility: Any of the following:
 - 1. A facility that can legally accept CDL waste materials for the purpose of processing the materials into an altered form for the manufacture of a new product.
 - 2. Material Recovery Facility: A general term used to describe a waste-sorting facility. Mechanical, hand-separation, or a combination of both procedures, are used to recover recyclable materials.

1.3 SUBMITTALS

- A. Contractor shall develop a Waste Management Plan: Submit 3 copies of plan within 14 days of date established for the **Notice to Proceed**.
- B. Contractor shall provide Waste Management Report: Concurrent with each Application for Payment, submit **3** copies of report.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Divert a minimum of **75%** CDL waste, by weight, from the landfill by one, or a combination of the following activities:
 - 1. Salvage
 - 2. Reuse
 - 3. Source-Separated CDL Recycling
 - 4. Co-mingled CDL Recycling

- B. CDL waste materials that can be salvaged, reused or recycled include, but are not limited to, the following:
 - 1. Acoustical ceiling tiles
 - 2. Asphalt
 - 3. Asphalt shingles
 - 4. Cardboard packaging
 - 5. Carpet and carpet pad
 - 6. Concrete
 - 7. Drywall
 - 8. Fluorescent lights and ballasts
 - 9. Land clearing debris (vegetation, stumpage, dirt)
 - 10. Metals
 - 11. Paint (through hazardous waste outlets)
 - 12. Wood
 - 13. Plastic film (sheeting, shrink wrap, packaging)
 - 14. Window glass
 - 15. Wood
 - 16. Field office waste, including office paper, aluminum cans, glass, plastic, and office cardboard.

1.4 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: Experienced firm, with a record of successful waste management coordination of projects with similar requirements, that employs a LEED Accredited Professional, certified by the USGBC as waste management coordinator.

- B. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

- C. Regulatory Requirements: Conduct construction waste management activities in accordance with hauling and disposal regulations of all authorities having jurisdiction and all other applicable laws and ordinances.

- D. Preconstruction Conference: Schedule and conduct meeting at Project site prior to construction activities.
 - 1. Attendees: Inform the following individuals, whose presence is required, of date and time of meeting.
 - a. Owner
 - b. Architect
 - c. Contractor's superintendent
 - d. Major subcontractors
 - e. Waste Management Coordinator
 - f. Other concerned parties

2. Agenda Items: Review methods and procedures related to waste management including, but not limited to, the following:
 - a. Review and discuss waste management plan including responsibilities of Waste Management Coordinator.
 - b. Review requirements for documenting quantities of each type of waste and its disposition.
 - c. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
 - d. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
 - e. Review waste management requirements for each trade.
 3. Minutes: Record discussion. Distribute meeting minutes to all participants.
Note: If there is a Project Architect, they will perform this role.
- 1.5 WASTE MANAGEMENT PLAN – Contractor shall develop and document the following:
- A. Develop a plan to meet the requirements listed in this section at a minimum. Plan shall consist of waste identification, waste reduction plan and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight throughout the plan.
 - B. Indicate anticipated types and quantities of demolition, site-cleaning and construction waste generated by the project. List all assumptions made for the quantities estimates.
 - C. List each type of waste and whether it will be salvaged, recycled, or disposed of in a landfill. The plan should include the following information:
 1. Types and estimated quantities, by weight, of CDL waste expected to be generated during demolition and construction.
 2. Proposed methods for CDL waste salvage, reuse, recycling and disposal during demolition including, but not limited to, one or more of the following:
 - a. Contracting with a deconstruction specialist to salvage materials generated,
 - b. Selective salvage as part of demolition contractor's work,
 - c. Reuse of materials on-site or sale or donation to a third party.
 3. Proposed methods for salvage, reuse, recycling and disposal during construction including, but not limited to, one or more of the following:
 - a. Requiring subcontractors to take their CDL waste to a recycling facility;
 - b. Contracting with a recycling hauler to haul recyclable CDL waste to an approved recycling or material recovery facility;
 - c. Processing and reusing materials on-site;
 - d. Self-hauling to a recycling or material recovery facility.
 4. Name of recycling or material recovery facility receiving the CDL wastes.
 5. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on project site where materials separation will be located.

- D. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Include the following:
1. Total quantity of waste.
 2. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.
 3. Total cost of disposal (with no waste management).
 4. Revenue from salvaged materials.
 5. Revenue from recycled materials.
 6. Savings in hauling and tipping fees by donating materials.
 7. Savings in hauling and tipping fees that are avoided.
 8. Handling and transportation costs. Including cost of collection containers for each type of waste.
 9. Net additional cost or net savings from waste management plan.

PART 2 - PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 CONSTRUCTION WASTE MANAGEMENT, GENERAL

- A. Provide containers for CDL waste that is to be recycled clearly labeled as such with a list of acceptable and unacceptable materials. The list of acceptable materials must be the same as the materials recycled at the receiving material recovery facility or recycling processor.
- B. The collection containers for recyclable CDL waste must contain no more than 10% non-recyclable material, by volume.
- C. Provide containers for CDL waste that is disposed in a landfill clearly labeled as such.
- D. Use detailed material estimates to reduce risk of unplanned and potentially wasteful cuts.
- E. To the greatest extent possible, include in material purchasing agreements a waste reduction provision requesting that materials and equipment be delivered in packaging made of recyclable material, that they reduce the amount of packaging, that packaging be taken back for reuse or recycling, and to take back all unused product. Insure that subcontractors require the same provisions in their purchase agreements.
- F. Conduct regular visual inspections of dumpsters and recycling bins to remove contaminants.

3.2 SOURCE SEPARATION

- A. General: Contractor shall separate recyclable materials from CDL waste to the maximum extent possible.

Separate recyclable materials by type.

1. Provide containers, clearly labeled, by type of separated materials or provide other storage method for managing recyclable materials until they are removed from Project site.
2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water and to minimize pest attraction. Cover to prevent windblown dust.

3. Stockpile materials away from demolition area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from weather.

3.3 CO-MINGLED RECYCLING

- A. General: Do not put CDL waste that will be disposed in a landfill into a co-mingled CDL waste recycling container.

REMOVAL OF CONSTRUCTION WASTE MATERIALS

- A. Remove CDL waste materials from project site on a regular basis. Do not allow CDL waste to accumulate on-site.
- B. Transport CDL waste materials off Owner's property and legally dispose of them.
- C. Burning of CDL waste is not permitted.

END OF SECTION

WASTE MANAGEMENT PROGRESS REPORT				
MATERIAL CATEGORY	DISPOSED IN MUNICIPAL SOLID WASTE LANDFILL	DIVERTED FROM LANDFILL BY RECYCLING, SALVAGE OR REUSE		
		Recycled	Salvaged	Reused
1. Acoustical Ceiling Tiles				
2. Asphalt				
3. Asphalt Shingles				
4. Cardboard Packaging				
5. Carpet and Carpet Pad				
6. Concrete				
7. Drywall				
8. Fluorescent Lights and Ballasts				
9. Land Clearing Debris (vegetation, stumpage, dirt)				
10. Metals				
11. Paint (through hazardous waste outlets)				
12. Wood				
13. Plastic Film (sheeting, shrink wrap, packaging)				
14. Window Glass				
15. Field Office Waste (office paper, aluminum cans, glass, plastic, and coffee cardboard)				
16. Other (insert description)				
17. Other (insert description)				
Total (In Weight)		(TOTAL OF ALL ABOVE VALUES – IN WEIGHT)		
		Percentage of Waste Diverted	(TOTAL WASTE DIVIDED BY TOTAL DIVERTED)	



ARCHITECTURE
ENGINEERING

Date:

Assawoman Canal Trail – Phase 1 – Electronic Media Release

Ocean View, Sussex County, Delaware
2012006.03

Release for use of Digital Media

Pursuant to your request, the digital media being provided is forwarded in accordance with the following terms.

Definitions:

- a. Digital Information: the information stored on Digital Media or sent via electronic exchange (email and FTP) known as the Work of the contracted design professional, Becker Morgan Group, Inc. and their consultants, herein after referred to as the Firm.
- b. Digital Media: the electronic, electromagnetic and/or optical storage media, (i.e. disk drives, tapes, compact or DVD discs, etc.) on which the Work is stored.
- c. The Work: the instrument of professional services of the Firm including but not limited to the design drawings, sketches, renderings, photographs, models, specifications.

Terms:

1. In accepting and utilizing Digital Information on any form of Digital Media or email generated and provided by the Firm, the Undersigned covenants and agrees that all such Digital Information are instruments of service of the Firm prepared solely for use in connection with the single project for which they were prepared, who shall be deemed the author of the Digital Information, and shall retain all common law, statutory law and other rights, including copyrights.
2. The Digital Documents are provided as a convenience to the Recipient for informational purposes only in connection with the Recipient's performance of its responsibilities and obligations relating to the Project. The Digital Documents are not Contract Documents and do not replace or supplement the paper copies of the Drawings and Specifications that are, and remain, the Contract Documents for the Project.
3. The Digital Information is provided only as a design record prior to construction and for reference to the Undersigned. The information in no way shall be used for "as-built" or record purposes.
4. The Undersigned agrees not to use this Digital Information, in whole or in part for any purpose or project other than the specific project for which the Undersigned and the Firm have a prior Professional Services Agreement. It is further understood and agreed that only printed copies of the Instruments of Services shall be signed and sealed by

Architect or its subconsultants in accordance with the laws of the state in which the project is built.

5. The Work cannot be distributed, altered, reused, sold, leased, printed, plotted, or duplicated without the expressed written consent of the Firm.
6. For Shop Drawings - Where the Recipient has received specific permission to use the Digital Documents in connection with Recipient's obligation to prepare certain documents for the Project, Recipient shall, in addition to the other obligations set forth herein, be obligated to remove Architect's or Architect's Consultant's title block from the copy of the Digital Documents used by Recipient. It is understood and agreed that the Digital Documents are not to be used by any contractor or any of its subcontractors of any tier or any material supplier or vendor as a shop drawing or any other type of submittal or as the basis for preparing such shop drawing or submittal. The sole exception to this prohibition shall be that the Recipient may use the Digital Documents as backgrounds upon which to prepare its shop drawing or other submittal when it is specifically permitted in technical section of project specification. When these digital documents are used as backgrounds in the preparation of shop drawings or other submittals, the Recipient agrees to confirm the accuracy of the digital documents before using them, Recipient agrees to accept all responsibility for any errors or inaccuracies and to release the Architect and its subconsultants from any liability or claims for recovery of damages or expenses arising as the result of such errors or inaccuracies.
7. Under no circumstances shall transfer of the Digital Information for use by the Undersigned be deemed a sale by the Firm. The parties agree that the Digital Documents are not, nor shall they be construed to be, a product. The Firm makes no warranties, either express or implied, of the Digital Media or the Digital Information as to merchantability or fitness for any particular purpose the Undersigned may need.
8. The Digital Information submitted by the Firm to the Undersigned is submitted for an acceptance period of sixty days. Any defects the Undersigned discovers during this period shall be reported to the Firm and may be corrected as part of the Firm's Basic Scope of Services. Correction of defects detected and reported after the acceptance period will be compensated for as Additional Services.
9. The Digital Information is not guaranteed as to accuracy and completeness of all dimensions and details. Information contained in the signed and sealed printed documents should be deemed to be correct and superior to digital information.
10. The Digital Information is not guaranteed as to compatibility, in so far as incompatibilities may be present now or in the future in the Undersigned's computers, storage devices, software, and output systems.
11. The Digital Media on which the Digital Information is provided cannot be guaranteed as to its durability, completeness or usability, in so far as instabilities may be present in the Digital Media, and in the transferring, archiving, recording or translating systems now and in the future. The Firm is not liable in any way for the perpetuation of this Digital Information on released digital media or on digital media retained by the Firm for its archives. Recipient agrees to accept all responsibility for any errors or inaccuracies and to release Architect and its subconsultants from any liability or claims for recovery of damages or expenses arising as the result of such errors or inaccuracies.
12. Provision of the Information to the Undersigned in no way limits the Firm to the further use of the Digital Information for the Firm's benefit.
13. Recipient agrees to waive any and all claims and liability against Architect and its subconsultants resulting in any way from any failure by Recipient to comply with the requirements of this Agreement for the Delivery of Documents in Digital Format. The Undersigned agrees, to the fullest extent permitted by law, to indemnify and hold the Firm harmless from any damage, liability or cost, including reasonable attorney's fees and costs of defense, arising from any changes made by anyone other than the Firm or from any reuse of the Digital Information without the prior written consent of the Firm.

Recipient further agrees to indemnify and save harmless the Owner, Architect and its subconsultants and each of their partners, officers, shareholders, directors and employees from any and all claims, judgments, suits, liabilities, damages, costs or expenses (including reasonable defense and attorneys fees) arising as the result of either: 1) Recipient's failure to comply with any of the requirements of this Agreement for the Delivery of Documents in Digital Format; or 2) a defect, error or omission in the Digital Documents or the information contained therein, which defect, error or omission was not contained in the Contract Documents as defined in Paragraph 2 or where the use of such Contract Documents would have prevented the claim, judgment, suit, liability, damage, cost or expense.

14. Check one:

- The Undersigned agrees to \$500 charge per digital file created payable to this office prior to release of any Digital Information. Note: it may be assumed that one printed drawing sheet is equivalent to one digital file.
- Charges are not applicable as provision of Digital Information is part of the Basic Scope Services.

Please sign below and return one copy of this form to our office.

Media/Information Received:

sign here>

Accepted - signature

Date

Name/Title – printed

Company

BMG Principal - signature

Date

BMG Principal – printed

Prepared by – printed

SECTION 02231

TREE PROTECTION AND TRIMMING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes labor, equipment and materials necessary for the protection and trimming of existing trees that interfere with, or are affected by, execution of the Work, whether temporary or permanent construction.

1.2 DEFINITIONS

- A. Tree Protection Zone: Area surrounding individual trees or groups of trees to remain during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.3 QUALITY ASSURANCE

- A. Standards

Code of Standards of the American Association of Nurserymen in the American Standard for Nursery Stock and National Arborist Association Standards for Pruning and Buying of Shade Trees.

1.4 PROJECT CONDITIONS

- A. Existing Conditions

1. Carefully examine the site before submitting a bid. Be informed of the site conditions including adjacent properties, utilities, and soil conditions.
2. Should the Contractor find any discrepancies between Drawings and physical conditions, inform the Owner's Representative and Landscape Architect immediately for clarification.

1.5 QUALITY ASSURANCE

- A. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed tree protection and trimming work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of tree protection and trimming.
- B. Arborist Qualifications: An arborist certified by ISA or licensed in the jurisdiction where Project is located.
- C. Tree Pruning Standard: Comply with ANSI A300 (Part 1), "Tree, Shrub, and Other Woody Plant Maintenance – Standard Practices (Pruning)."

- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section “Project Management and Coordination.”
 - 1. Before tree protection and trimming operations begin, meet with representatives of authorities having jurisdiction, Owner, Architect, consultants, and other concerned entities to review tree protection and trimming procedures and responsibilities.

1.6 TREE PROTECTION

- A. Protect all trees and other plant material scheduled to remain. Do not park any vehicles or equipment, store materials or stockpiled soil, dispose of building materials, chemicals, petroleum products, or other detrimental substances, secure cable, chain or rope to trees or shrubs, apply soil sterilants under pavement near existing trees within limits of tree protection fencing or any existing tree to remain. Protect existing trees from flame, smoke, and heat. Construction access to site shall not occur beneath drip line of existing trees until special provisions have been met to protect all existing vegetation to remain. The Contractor shall be responsible for all damage to existing trees and plant material during construction. All clearing and grubbing or excavation within limits of tree protection fencing shall be done by hand methods.
- B. Provide protective temporary fencing during the work as necessary to protect existing vegetation to remain.
- C. Root Protection - Protect all tree roots within the tree protection root zone. If tree roots are encountered during excavation for path, roots shall be cut with pruner or saw. Roots shall not be pulled out by excavator or other equipment.

1.7 FAILURE TO PRESERVE TREES

- A. Trees that are designated to remain, which become damaged or die, shall be reviewed by the Owner’s Representative prior to tree replacement. (NOT INCLUDING SIGNIFICANT TREES.)
- B. If the Contractor damages or destroys an existing tree, shrub and/or groundcover which he/she has been directed to preserve due to failure to comply with Specifications and Drawings, the Contractor shall replace it with trees at twelve (12) foot height, shrubs at twenty-four (24) inch height and groundcovers at one (1) gallon containers spaced at eighteen (18) inches on center with same plant species, size and grade, with a healthy tree and/or shrub acceptable to the Owner, and the contractor shall guarantee that the tree, shrub and/or groundcover shall live for a period of one (1) year from Owner’s Acceptance.
- C. The Owner shall charge the Contractor damages to a **SIGNIFICANT EXISTING TREE** (twelve (12) inch caliper and larger) as measured 3’ above lowest grade immediately adjacent to said tree. The Owner shall charge the Contractor at the rate of one hundred (100) dollars per square inch of damaged area. The following are examples of damage to a tree above and below ground surface: scrapes and other abrasions penetrating to the cambium layer of the main or lateral stem, splits in the bark and between main stem and lateral stems, rips, shredding, gouges, cuts, avulsions of tree parts, and dents. The calculated value of the significant tree, as described

above, shall be deducted from the contract amount. It is the Contractor's responsibility to notify the Owner immediately after damage has occurred.

- D. The Owner shall charge the Contractor the following rates for destroyed existing trees, which cannot be replaced: \$100.00 per square inch of cross sectional area measured three (3) feet above existing grade for trees up to and including six (6) inch caliper; and at the rate of \$200.00 per square inch of cross sectional areas measure three (3) feet above existing grade for trees between seven (7) to eleven (11) inch caliper. This amount shall be credited to the Owner. (NOT INCLUDING SIGNIFICANT TREES TWELVE (12) INCH CALIPER AND LARGER.)
- E. Remove any damaged and destroyed trees from the site. All trees are not to be removed unless evaluated by the Landscape Architect prior to being cut down and removed from the site. Grub stumps and repair the ground surface. All costs shall be borne by the Contractor.

1.8 INSPECTIONS

- A. Monthly inspections to monitor the effectiveness of the Tree Protection Plan will be done by Owner's Representative. Report with conditions and recommendations will be provided after every inspection.

END OF TREE PROTECTION SECTION

SECTION 02410 – DEMOLITION AND DECONSTRUCTION

TABLE OF ARTICLES

1	GENERAL CONDITIONS
2	PRODUCTS
3	EXECUTION

ARTICLE 1: GENERAL CONDITIONS

1.1. SCOPE. Do not begin demolition or deconstruction until authorization is received from the Owner. The work of this section is to be performed in a manner that maximizes salvage and recycling of materials. Remove rubbish and debris from the project site; do not allow accumulations inside or outside the buildings. The work includes demolition, deconstruction, salvage of identified items and materials, and removal of resulting rubbish and debris. Remove rubbish and debris from property daily, unless otherwise directed. Store materials that cannot be removed daily in areas specified by the Owner's Representative. In the interest of occupational safety and health, perform the work in accordance with EM 385-1-1, Section 23, Demolition.

1.2. SUBMITTALS.

1.2.1 DEMOLITION PLAN Prepare a Demolition Plan and submit proposed salvage, demolition, deconstruction and removal procedures for approval before work is started. Include in the plan procedures for careful removal and disposition of materials specified to be salvaged, coordination with other work in progress, a disconnection schedule of utility services, and a detailed description of methods and equipment to be used for each operation and of the sequence of operations. Materials to be salvaged will include the stone facade of the administrative building and concrete of structures as indicated on the Contract Drawings, if the Bid Alternates including this Work are accepted by the Owner. Demolition Plan will state the Contractor will be responsible for producing disposal manifests, certified by the contractor, for all removed materials indicating type, quantities, condition, destination, and end use. Coordinate with Waste Management Plan. Demolition Plan will include Contractor's procedures inspecting facilities and determining suitability to perform as a safe working platform or if inspection reveals a safety hazard to workers, state provisions for securing the safety of the workers throughout the performance of the work.

Plan shall be approved by Owner's representative prior to work beginning. Owner's representative assumes no liability regarding the plan.

1.2.2 DISPOSAL MANIFESTS Contractor will produce, certify and submit disposal manifests for all materials being transported from the site. Manifests shall indicate, type of material, quantity of material, material hauler, and end use/disposal facility. Manifests shall be submitted on a daily basis for the previous days work.

1.2.3 EXISTING CONDITIONS Contractor shall inspect work areas and submit documentation of facilities to remain which are in questionable condition prior to beginning work in that area. Documentation shall be in accordance with paragraph 1.8 of this specifications section.

1.3. REFERENCES. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

1.3.1. AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI Guideline K (2009) Guideline for Containers for Recovered Non-Flammable Fluorocarbon Refrigerants

1.3.2 AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M145 (1991; R 2004) Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes **AASHTO T 180** (2009) Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm(18-in.)

1.3.3 AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE) **ASSE/SAFE A10.6**

(2006) Safety Requirements for Demolition Operations

1.3.4 CARPET AND RUG INSTITUTE (CRI) **CRI 104** (2002) Standard for Installation Specification of Commercial Carpet

1.3.5 U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2008) Safety and Health Requirements Manual

1.3.6 U.S. DEFENSE LOGISTICS AGENCY (DLA)

DLA 4145.25 (June 2000) Storage and Handling of Liquefied and Gaseous Compressed Gases and Their Full and Empty Cylinders

1.3.7 US DEPARTMENT OF DEFENSE (DOD)

DOD 4000.25-1-M (2004) Military Standard Requisitioning and Issue Procedures **MIL-STD-129** (2007; Rev P; Change 4) Military Marking for Shipment and Storage

1.3.8 U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 70/7460-1 2007; Rev K) Obstruction Marking and Lighting

1.3.9 U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 61 National Emission Standards for Hazardous Air Pollutants **40CFR 82** Protection of Stratospheric Ozone **49 CFR 173.301** Shipment of Compressed Gases in Cylinders and Spherical Pressure Vessels

1.4. ITEMS TO REMAIN IN PLACE Take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Owner. Repair or replace damaged items as approved by the Owner/Engineer. Coordinate the work of this section with all other work indicated. Construct and

maintain shoring, bracing, and supports as required. Ensure that structural elements are not overloaded. Increase structural supports or add new supports as may be required as a result of any cutting, removal, deconstruction, or demolition work performed under this contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition, deconstruction, or removal work. Repairs, reinforcement, or structural replacement require approval by the Owner's Representative prior to performing such work.

1.4.1. EXISTING CONSTRUCTION LIMITS AND PROTECTION

Do not disturb existing construction beyond the extent indicated or necessary for installation of new construction. Provide temporary shoring and bracing for support of building components to prevent settlement or other movement. Provide protective measures to control accumulation and migration of dust and dirt in all work areas. Remove snow, dust, dirt, and debris from work areas daily.

1.4.2. TREES.

Protect trees within the project site which might be damaged during demolition or deconstruction, and which are indicated to be left in place. Replace any tree damaged during the work under this contract with like-kind or as approved by the Owner's Representative.

1.4.3. UTILITY SERVICE

Maintain existing utilities indicated to stay in service and protect against damage during demolition and deconstruction operations. Prior to start of work, utilities serving each area of the site to be demolished will be disconnected and sealed by the Contractor.

1.4.4 FACILITIES.

Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities. Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, must remain standing without additional bracing, shoring, or lateral support until demolished or deconstructed, unless directed otherwise by the Owner/Engineer. Ensure that no elements determined to be unstable are left unsupported and place and secure bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, deconstruction, or demolition work performed under this contract.

1.5. QUALITY ASSURANCE

Furnish timely notification of demolition projects to State authorities in accordance with 40 CFR 61, Subpart M. Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the "Contract Clauses," conform to the safety requirements contained in ASSE/SAFE A10.6. Comply with the Environmental Protection Agency requirements specified. Use of explosives will not be permitted.

- 1.6. DUST AND DEBRIS CONTROL Prevent the spread of dust and debris and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution.

1.7. PROTECTION

1.7.1. TRAFFIC CONTROL SIGNS

Where pedestrian and driver safety is endangered in the area of removal work, use traffic barricades with flashing lights meeting DeDOT standards for products and configuration. Anchor barricades in a manner to prevent displacement by wind or other weather conditions. Notify the Owner's Representative prior to beginning such work.

1.7.2. PROTECTION OF PERSONNEL

Before, during and after the demolition and deconstruction work continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the project site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

1.8. EXISTING CONDITIONS

Before beginning any demolition or deconstruction work, survey the site and examine the drawings and specifications to determine the extent of the work. Record existing conditions in the presence of the Owner's Representative showing the condition of structures and other facilities adjacent to areas of alteration or removal. Photographs sized 4 inch will be acceptable as a record of existing conditions. Include in the record the elevation of the top of foundation walls, finish floor elevations, possible conflicting electrical conduits, plumbing lines, alarms systems, the location and extent of existing cracks and other damage and description of surface conditions that exist prior to before starting work. It is the Contractor's responsibility to arrange, verify and document all required outages which will be required during the course of work, and to note these outages on the record document.

ARTICLE 2: PRODUCTS

NOT USED

ARTICLE 3: EXECUTION

- 3.1 EXISTING FACILITIES TO BE REMOVED Inspect and evaluate existing structures onsite for reuse. Existing construction scheduled to be removed for reuse shall be disassembled. Dismantled and removed materials are to be separated, set aside, and prepared for delivery to a collection point for reuse, remanufacture, recycling, or other disposal, as specified. Materials shall be designated for reuse onsite whenever possible, as indicated by Contract Documents and as approved by the Owner/Engineer.

3.1.1. STRUCTURES

The existing building foundation that is indicated to be removed shall be removed in its entirety, including all associated reinforcement and other structural components.

Remove existing structures indicated to be removed to a minimum depth of 36 inches below proposed grade. Foundations greater than 36 inches below proposed grade, may remain in place provided they are destroyed to condition that will prevent collection of groundwater.

Demolish structures in a systematic manner from the top of the structure to the ground. Complete demolition work above each tier or floor before the supporting members on the lower level are disturbed. Demolish concrete and masonry walls in small sections. Remove structural framing

members and lower to ground by means of derricks, platforms hoists, or other suitable methods as approved by the Owner/Engineer.

Locate demolition and deconstruction equipment throughout the structure and remove materials so as to not impose excessive loads to supporting walls, floors, or framing.

Building, or the remaining portions thereof, not exceeding 80 feet in height may be demolished by the mechanical method of demolition except for the Administration Building as identified on the plans. The Administration Building shall be demolished systematically and may not be demolished by mechanical methods.

3.1.2. UTILITIES AND RELATED EQUIPMENT

3.1.2.1. GENERAL REQUIREMENTS.

Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by the Owner/Engineer. Do not interrupt existing utilities serving facilities occupied and used by the Owner except when approved in writing and then only after temporary utility services have been approved and provided. Do not begin demolition or deconstruction work until all utility disconnections have been made. Shut off and cap utilities for future use, as indicated.

3.1.2.2. DISCONNECTING EXISTING UTILITIES

Remove existing utilities as indicated and terminate in a manner conforming to the nationally recognized code covering the specific utility, as required by utility provider's requirements and approved by the Owner's Representative. When utility lines are encountered but are not indicated on the drawings, notify the Owner's Representative prior to further work in that area. Remove meters and related equipment and deliver to a location in accordance with instructions of the Owner's Representative.

3.1.3. PAVING AND SLABS

Remove within the limit of disturbance the entire depth of concrete and asphaltic concrete paving and slabs including aggregate base. Provide neat sawcuts at limits of pavement removal. Pavement and slabs shall be removed from the Site at the Contractor's expense.

3.1.4. MASONRY.

Sawcut and remove masonry so as to prevent damage to materials being salvaged.

3.1.5. CONCRETE.

Saw concrete along straight lines to a depth of a minimum 4 inch. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. Break out the remainder of the concrete. Salvage removed concrete to the most practical levels.

3.1.6. STRUCTURAL STEEL.

Dismantle structural steel at field connections and in a manner that will prevent bending or damage. Salvage for recycle structural steel, steel joists, girders, angles, plates, columns and shapes. Do not use flame-cutting torches. Transport steel joists and girders as whole units and not dismantled. Transport structural steel shapes to a recycling facility, designated by the

contractor protected from the weather.

3.1.7. MISCELLANEOUS METAL

Salvage shop-fabricated items such as access doors and frames, steel gratings, metal ladders, wire mesh partitions, metal railings, metal windows and similar items as whole units. Salvage light-gage and cold-formed metal framing, such as steel studs, steel trusses, metal gutters, roofing and siding, metal toilet partitions, toilet accessories and similar items. Scrap metal shall become the Contractor's property. Recycle scrap metal as part of demolition and deconstruction operations. Provide separate containers to collect scrap metal and transport to a scrap metal collection or recycling facility.

3.1.8. CARPENTRY

When possible salvage for reuse lumber, millwork items, and finished boards, and sort by type and size.

END OF SECTION 02410 – DEMOLITION AND DECONSTRUCTION

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SECTION 032016 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:

1. Warm-mix and hot-mix asphalt paving.
2. Warm-mix and hot-mix asphalt patching.
3. Warm-mix and hot-mix asphalt paving overlay.
4. Asphalt surface treatments.
5. Pavement-marking paint.
6. Cold milling of existing hot-mix asphalt pavement.

- B. Related Sections include the following:

1. Division 31 Section "Earth Moving" for aggregate subbase and base courses and for aggregate pavement shoulders.

1.3 DEFINITIONS

- A. Warm-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.
- B. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.
- C. DOT: Delaware Department of Transportation.

1.4 SYSTEM DESCRIPTION

- A. Provide warm-mix (WMA) and hot-mix (HMA) asphalt paving according to materials, workmanship, and other applicable requirements of Specifications for road and Bridge Construction of the Delaware Department of Transportation.
 1. Standard Specification: Division 400; including all updates.
 2. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
- B. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
- C. Job-Mix Designs: For each job mix proposed for the Work.

- D. Qualification Data: For manufacturer.
- E. Material Test Reports: For each paving material.
- F. Material Certificates: For each paving material, signed by manufacturers.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer.
 - 1. Manufacturer shall be a paving-mix manufacturer registered with and approved by authorities having jurisdiction or the DOT of the state in which Project is located.
- B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated, as documented according to ASTM E 548.
- C. Regulatory Requirements: Comply with Delaware Department of Transportation Specifications for Road and Bridge Construction for asphalt paving work.
- D. All paving section materials, striping and signage shall be as outlined in the DE MUTCD.
- E. Asphalt-Paving Publication: Comply with AIMS-22, "Construction of Hot Mix Asphalt Pavements," unless more stringent requirements are indicated.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
- G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to WMA and HMA asphalt paving including, but not limited to, the following:
 - 1. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture WMA and HMA asphalts.
 - 2. Review condition of subgrade and preparatory work.
 - 3. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
 - 4. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

1.7 DELIVERY, STORAGE, AND HANDLING

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

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp. Adhere to all specifications in Delaware Department of Transportation Specifications for Road and Bridge Construction.
- B. Pavement-Marking Paint, Epoxies and Thermo-Plastics: Proceed with pavement marking only on clean, dry surfaces and at minimum ambient or surface temperatures specified in the Delaware Department of Transportation Specifications for Road and Bridge Construction.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials: All materials used under this section shall conform to the requirements of Delaware Department of Transportation Specifications for Road and Bridge Construction and the Delaware Manual on Uniform Traffic Control Devices (MUTCD), including, but not limited to: graded aggregate, asphalt cement, tack coat and traffic control devices.
- B. Herbicide Treatment: Commercial chemical for weed control, registered by Environmental Protection Agency. Provide granular, liquid or wettable powder form. Obtain written approval from the Maryland Department of the Environment prior to application of the herbicide.
 - 1. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
 - a. Ciba-Geigy Corp.
 - b. Dow Chemical, USA
 - c. E.I. Du Pont de Nemours & Co., Inc.
 - d. FMC Corp
 - e. Thompson-Hayward Chemical Co.
 - f. U.S. Borax and Chemical Corp.
 - g. Allied Chemical Corp.
 - h. Ag-Chem Products, Inc.
- C. Lane Markings: Thermoplastic, epoxy other types of lane marking materials for WMA, HMA and concrete surfaces shall comply with Division 700 of the Delaware Department of Transportation Specifications for Road and Bridge Construction; and the Delaware Department of Transportation, Striping Item Guidelines.
 - 1. Color: White
 - 2. Color: Yellow
 - 3. Color: Blue
- D. Joint Sealants: Joint Sealants shall comply with Delaware Department of Transportation Specifications for Road and Bridge Construction, Divisions 700 & 800.

2.2 MIXES

- A. WMA and HMA Asphalt: Provide Plant Mixed, hot-laid, asphalt-aggregate mixture complying with Delaware Department of Transportation Specifications for Road and Bridge Construction, Division 400 and referred Divisions.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. Verify that subgrade is dry and in suitable condition to support paving and imposed loads. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.
- B. Proof-roll subbase using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction.
- C. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.
 - 1. Mix herbicide with if formulated by manufacturer for that purpose.
 - 2. Remove spillages and clean affected surfaces.
- D. Proceed with paving only after unsatisfactory conditions have been corrected.
- E. Tack Coat: Apply to contact surfaces of previously constructed asphalt or Portland cement concrete and surfaces abutting or projecting into hot-mixed asphalt pavement. Distribute at a rate of 0.05 to 0.15 gal. Per sq. yd. of surface in accordance Section 401 of the Delaware Department of Transportation Specifications for Road and Bridge Construction.
- F. Allow to dry until at proper condition to receive paving.
- G. Exercise care in applying bituminous materials to avoid smearing of adjoining concrete surfaces. Remove and clean damaged surfaces.

3.2 COLD MILLING

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

3.3 PATCHING

- A. WMA and HMA Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.
- B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseal concrete pieces firmly.
 - 1. Pump hot undersealing asphalt under rocking slabs until slab is stabilized or, if necessary, crack slab into pieces and roll to reseal pieces firmly.
 - 2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.
- C. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd..
 - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- D. Patching: Fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact flush with adjacent surface.
- E. Patching: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.4 REPAIRS

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

3.5 ASPHALT PLACING

- A. Machine place WMA and HMA asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
 - 1. Place WMA and HMA asphalt base course in number of lifts and thicknesses indicated.
 - 2. Place WMA and HMA asphalt surface course in single lift.
 - 3. Spread HMA mix at minimum temperature of 225 deg F.
 - 4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes, unless otherwise indicated.
 - 5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
 - 1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.
- C. Immediately correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.
- D. Place final paving course after receiving written approval of Owner.

3.6 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course. Joints shall comply with Delaware Department of Transportation Specifications for Road and Bridge Construction, Section 401.12.
 - 1. Clean contact surfaces and apply tack coat to joints.
 - 2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
 - 3. Offset transverse joints, in successive courses, a minimum of 24 inches.
 - 4. Construct transverse joints as described in AI MS-22, "Construction of Hot Mix Asphalt Pavements."
 - 5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
 - 6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.7 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.
 - 1. Complete compaction before mix temperature cools to 185 deg F.

- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
 - 1. Average Density: 98 percent of reference laboratory density according to AASHTO T 209, but not less than 96 percent nor greater than 100 percent.
 - 2. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent nor greater than 96 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.8 INSTALLATION TOLERANCES

- A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:
 - 1. Base Course: Plus or minus 1/2 inch.
 - 2. Surface Course: Plus 1/4 inch, no minus.
- B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
 - 1. Base Course: 1/4 inch.
 - 2. Surface Course: 1/8 inch.
 - 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.9 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Owner, Municipality and DelDOT where jurisdiction applies.

- B. Contractor shall provide striping on parking and roadway surfaces as indicated on the plans. The following is a list of all required striping:
 - 1. Parking stalls.
 - 2. Cross-hatch/gore areas.
 - 3. Handicap Parking symbols.
 - 4. Stop bars.
 - 5. Directional arrows.
 - 6. Lane lines.
 - 7. Words/numbers.
- C. Allow paving to age for 30 days before starting pavement marking.
- D. Sweep and clean surface to eliminate loose material and dust.
- E. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.
 - 1. Broadcast glass spheres uniformly into wet pavement markings at a rate of 6 lb/gal. for all markings with the exception of parking stall lines.

3.10 WHEEL STOPS

- A. Securely attach wheel stops into pavement with not less than two galvanized steel dowels embedded at one-quarter to one-third points. Securely install dowels into pavement and bond to wheel stop. Recess head of dowel beneath top of wheel stop.

3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor will engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.
 - 1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from specified requirements.
- B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- C. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
- D. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- E. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979 or AASHTO T 168.
 - 1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.

2. In-place density of compacted pavement will be determined by testing core samples, when requested by the owner, according to ASTM D 1188 or ASTM D 2726.
 - a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.
 - b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.
- F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.12 DISPOSAL

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

END OF SECTION 032016

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Footings.
 - 2. Foundation walls.
 - 3. Slabs-on-grade.
 - 4. Head walls.
- B. Related Sections include the following:
 - 1. Division 2 Section "Earthwork" for drainage fill under slabs-on-grade.
 - 2. Division 2 Section "Cement Concrete Pavement" for concrete pavement and walks.

1.3 DEFINITIONS

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

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Samples: For waterstops and vapor retarder.

- E. Welding certificates.
- F. Qualification Data: For Installer, manufacturer, testing agency.
- G. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 - 1. Aggregates.
- H. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Form materials and form-release agents.
 - 4. Steel reinforcement and accessories.
 - 5. Curing compounds.
 - 6. Floor and slab treatments.
 - 7. Bonding agents.
 - 8. Adhesives.
 - 9. Vapor retarders.
 - 10. Semirigid joint filler.
 - 11. Joint-filler strips.
 - 12. Repair materials.
- I. Floor surface flatness and levelness measurements to determine compliance with specified tolerances.
- J. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
 - 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency

laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- E. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."
- F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specification for Structural Concrete,"
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 - 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 FORM-FACING MATERIALS

- A. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- B. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.
- C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- D. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
1. Furnish units that will leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
 2. Furnish ties that, when removed, will leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- B. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60 (Grade 420) , deformed bars, assembled with clips.
- C. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

2.4 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, cut bars true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.5 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
1. Portland Cement: ASTM C 150, Type I/II, gray. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class C.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Silica Fume: ASTM C 1240, amorphous silica.

- C. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.
 - 1. Maximum Coarse-Aggregate Size: 1 inch (25 mm) nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Water: ASTM C 94/C 94M and potable.

2.6 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - 3. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 - 4. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
- C. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494/C 494M, Type C.
 - 1. Products:
 - a. Boral Material Technologies, Inc.; Boral BCN.
 - b. Euclid Chemical Company (The); Eucon CIA.
 - c. Grace Construction Products, W. R. Grace & Co.; DCI.
 - d. Master Builders, Inc.; Rheocrete CNI.
 - e. Sika Corporation; Sika CNI.
- D. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.
 - 1. Products:
 - a. Axim Concrete Technologies; Catexol 1000CI.
 - b. Boral Material Technologies, Inc.; Boral BCN2.
 - c. Cortec Corporation; MCI 2000.
 - d. Grace Construction Products, W. R. Grace & Co.; DCI-S.
 - e. Master Builders, Inc.; Rheocrete 222+.
 - f. Sika Corporation; FerroGard-901.
- E. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

1. Manufacturers:
 - a. Bayer Corporation.
 - b. ChemMasters.
 - c. Conspec Marketing & Manufacturing Co., Inc.; a Dayton Superior Company.
 - d. Davis Colors.
 - e. Elementis Pigments, Inc.
 - f. Hoover Color Corporation.
 - g. Lambert Corporation.
 - h. Scofield, L. M. Company.
 - i. Solomon Colors.
2. Color: As selected by Architect from manufacturer's full range.

2.7 VAPOR RETARDERS

- A. Plastic Vapor Retarder: ASTM E 1745, Class C, or polyethylene sheet, ASTM D 4397, not less than 10 mils (0.25 mm) thick. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.
 1. Products:
 - a. Fortifiber Corporation; Moistop Plus.
 - b. Raven Industries Inc.; Dura Skrim 8.
 - c. Reef Industries, Inc.; Griffolyn Type-85.
 - d. Stego Industries, LLC; Stego Wrap, 10 mils.
- B. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.

2.8 FLOOR AND SLAB TREATMENTS

- A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; colorless; that penetrates, hardens, and densifies concrete surfaces.
 1. Products:
 - a. Dayton Superior Corporation; Day-Chem Sure Hard.
 - b. Euclid Chemical Company (The); Euco Diamond Hard.
 - c. L&M Construction Chemicals, Inc.; Seal Hard.
 - d. Meadows, W. R., Inc.; Liqui-Hard.
- B. Stained Hardener with matching cure/sealer - Pigmented Mineral Dry-Shake Floor Hardener: Factory-packaged, dry combination of portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, nonfading mineral oxides interground with cement. Placing of hardener is followed by manufacturer's recommended water membrane-forming cure and seal: ASTM C 309

1. Products:
 - a. L&M Construction Chemicals, Inc.; Quartz Plate FF Hardener followed by Dress & Seal WB 30 per manufacturer's recommendations and specifications.
 - b. Scofield, L. M. Company; Lithochrome Color Hardener followed by Lithochrome Colorwax in matching color per manufacturer's recommendations and specifications.

2.9 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
 1. Products:
 - a. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Aquafilm.
 - b. Dayton Superior Corporation; Sure Film.
 - c. Euclid Chemical Company (The); Eucobar.
 - d. L&M Construction Chemicals, Inc.; E-Con.
 - e. Meadows, W. R., Inc.; Sealtight Evapre.
 - f. Sika Corporation, Inc.; SikaFilm.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
 1. Products:
 - a. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).
 - b. Euclid Chemical Company (The); Kurez DR VOX.
 - c. L&M Construction Chemicals, Inc.; L&M Cure R.
 - d. Meadows, W. R., Inc.; 1100 Clear.
 - e. Tamms Industries, Inc.; Horncure WB 30.

2.10 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.
- B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- C. Reglets: Fabricate reglets of not less than 0.0217-inch- (0.55-mm-) thick, galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

2.11 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.
1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
 4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.
1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
 4. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested according to ASTM C 109/C 109M.

2.12 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
1. Fly Ash: 25 percent.
 2. Combined Fly Ash and Pozzolan: 25 percent.
 3. Ground Granulated Blast-Furnace Slag: 50 percent.
 4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
 5. Silica Fume: 10 percent.
 6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
 7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

- C. Limit water-soluble, chloride-ion content in hardened concrete to **[0.06] [0.15] [0.30] [1.00]** percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 - 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
- E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.13 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Footings: Proportion normal-weight concrete mixture as follows:
 - 1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.50.
 - 3. Slump Limit: 3 inch minimum and 5 inch maximum (at point of concrete placement), plus or minus 1 inch (25 mm).
- B. Foundation Walls: Proportion normal-weight concrete mixture as follows:
 - 1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.50.
 - 3. Slump Limit: 3 inch minimum and 5 inch maximum (at point of concrete placement), plus or minus 1 inch (25 mm).
- C. Slabs-on-Grade - Interior: Proportion normal-weight concrete mixture as follows:
 - 1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
 - 2. Minimum Cementitious Materials Content: 520 lb/cu. yd. (309 kg/cu. m).
 - 3. Slump Limit: 3 inch minimum and 5 inch maximum (at point of concrete placement), plus or minus 1 inch (25 mm).
- D. Slabs-on-Grade – Exterior (Exposed to Exterior Conditions): Proportion normal-weight concrete mixture as follows:
 - 1. Minimum Compressive Strength: 4500 psi (31 MPa) at 28 days.
 - 2. Minimum Cementitious Materials Content: 520 lb/cu. yd. (309 kg/cu. m).
 - 3. Slump Limit: 3 inch minimum and 5 inch maximum (at point of concrete placement), plus or minus 1 inch (25 mm).
 - 4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch (25-mm) nominal maximum aggregate size.
 - 5. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent.

2.14 FABRICATING REINFORCEMENT

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

2.15 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
 - 1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 - 2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
 - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
 - 1. Class C, 1/2 inch (13 mm) for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.

- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
 - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

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

3.4 SHORES AND RESHORES

- A. Comply with ACI 318 (ACI 318M) and ACI 301 for design, installation, and removal of shoring and reshoring.
 - 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR RETARDERS

- A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.
- B. Bituminous Vapor Retarders: Place, protect, and repair vapor retarders according to manufacturer's written instructions.
- C. Granular Course: Cover vapor retarder with granular fill, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch (0 mm) or minus 3/4 inch (19 mm).

3.6 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 - 1. Weld reinforcing bars according to AWS D1.4, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.7 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
 - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
 - 2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Division 7 Section "Joint Sealants," are indicated.
 - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- F. Hot-Weather Placement: Comply with ACI 301 and as follows:
 - 1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.9 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces not exposed to public view.
- B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.10 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 1. Apply a trowel finish to surfaces indicated, exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 - 2. Finish surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.
 - 3. Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-foot- (3.05-m-) long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed 1/4 inch (6 mm).
- C. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.11 MISCELLANEOUS CONCRETE ITEMS

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

- B. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

3.12 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project..
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall

within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

- a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.13 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.14 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension in solid concrete, but not less than 1 inch (25 mm) in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match

- before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.
- 3.15 FIELD QUALITY CONTROL
- A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

- B. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
1. Steel reinforcement placement.
 2. Steel reinforcement welding.
 3. Headed bolts.
 4. Verification of use of required design mixture.
 5. Concrete placement, including conveying and depositing.
 6. Curing procedures and maintenance of curing temperature.
 7. Verification of concrete strength before removal of shores and forms from beams and slabs.
- D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
 2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
 6. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 7. Compression Test Specimens: ASTM C 31/C 31M.
 - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
 - b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
 8. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.

- b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
 9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
 10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
 11. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
 12. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
 13. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
 14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 15. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- E. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 48 hours of finishing.

END OF SECTION 033000

SECTION 033030 - CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes exterior cement concrete pavement for the following:
 - 1. Driveways and roadways.
 - 2. Parking lots.
 - 3. Curbs and gutters.
 - 4. Walkways.
 - 5. Truncated domes.
- B. Related Sections include the following:
 - 1. Division 03 Section "Cast-in-Place Concrete" for general building applications of concrete.
 - 2. Division 31 Section "Earth Moving" for subgrade preparation, grading, and subbase course.
 - 3. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants of joints in concrete pavement and at isolation joints of concrete pavement with adjacent construction.

1.3 DEFINITIONS

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

1.4 SUBMITTALS

- A. Product Data:
 - 1. Concrete; mix and supplier information.
 - 2. Truncated domes.
- B. Design Mixtures: For each concrete pavement mixture. Include alternate mixture designs when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Samples: 10-lbsample of exposed aggregate.
- D. Qualification Data: For manufacturer. Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
- E. Material Test Reports: General contractor will engage a qualified testing agency for indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:

1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.
- F. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:
1. Cementitious materials.
 2. Steel reinforcement and reinforcement accessories.
 3. Fiber reinforcement.
 4. Admixtures.
 5. Curing compounds.
 6. Applied finish materials.
 7. Bonding agent or epoxy adhesive.
 8. Joint fillers.
- G. Field quality-control test reports.
- H. For plazas and wide walkways, submit control joint spacing plan for review.
- I. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment.
1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
- C. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.
- D. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Build mockups of full-thickness sections of concrete paving to demonstrate typical joints; surface finish, texture, and color; curing; and standard of workmanship.
 2. Build mockups of concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Owner and not less than 96 inches by 96 inches
 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations in writing.

4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
1. Before submitting design mixtures, review concrete pavement mixture design and examine procedures for ensuring quality of concrete materials and concrete pavement construction practices. Require representatives, including the following, of each entity directly concerned with concrete pavement, to attend conference:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete producer.
 - d. Concrete pavement subcontractor.

1.6 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 2. Products: Subject to compliance with requirements, provide one of the products specified.
 3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FORMS

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

2.3 STEEL REINFORCEMENT

- A. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
- B. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.
- C. Epoxy-Coated Welded Wire Fabric: ASTM A 884/A 884M, Class A, plain steel.
- D. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.
- E. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615/A 615M, Grade 60 deformed bars.
- F. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 deformed bars.
- G. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60, deformed bars; assembled with clips.
- H. Plain Steel Wire: ASTM A 82, as drawn.
- I. Deformed-Steel Wire: ASTM A 496.
- J. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A coated, plain.
- K. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.
- L. Epoxy-Coated Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60, plain steel bars.
- M. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.
- N. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete, and as follows:
 - 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
 - 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
- O. Epoxy Repair Coating: Liquid two-part epoxy repair coating, compatible with epoxy coating on reinforcement.
- P. Zinc Repair Material: ASTM A 780.

2.4 CONCRETE MATERIALS

- A. Materials: All materials including but not limited to reinforcing materials, concrete materials, concrete mix, admixtures, curing materials, traffic paint and other related materials used under this section shall conform to the requirements of the Delaware Department of Transportation Specifications for Road and Bridge Construction. References to a required class of concrete shall correspond to the classes as shown in the State of Delaware Department of Transportation Specifications for Road and Bridge Construction Division 500 and Division 800.
- B. Fly ash shall meet the approval of the ASTM C-618 pozzolan Class F and may be used as a partial substitute for cement when approved by the Owner.
- C. The concrete mix used in performing this work shall be DeIDOT Class “A” or DeIDOT Class “B” depending on the compressive strength shown on the details and shall meet the approval of the Owner.
- D. The concrete temperature shall not exceed 90°F when delivered to the job-site or at any time prior to placement in the forms.
- E. Type I - Portland Cement: Shall be used from October 1 through May 1 and when the air temperature in the shade and away from artificial heat is above 70°F or less, or as directed by the Owner.
- A. Type II - Portland Cement: Shall be used from May 1 through October 1 and when the air temperature in the shade and away from artificial heat is above 70°F, or as directed by the Owner.
- F. When approved by the Owner, Hi-Early strength concrete may be used. Approval will be on a case by case basis.
- G. Exposed Aggregate: Selected, hard, and durable; washed; free of materials with deleterious reactivity to cement or that cause staining; from a single source, with gap-graded coarse aggregate as follows:
 - 1. Aggregate Sizes: 1/2 to 3/4 inch nominal.
 - 2. Aggregate Source, Shape, and Color: Submit color samples for review by Owner.
- H. Water: ASTM C 94/C 94M.
- I. Air-Entraining Admixture: ASTM C 260.
- J. Chemical Admixtures: Admixtures may only be use with prior approval by the Owner. Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.5 FIBER REINFORCEMENT

- A. Synthetic Fiber: fibrillated polypropylene fibers engineered and designed for use in concrete pavement, complying with ASTM C 1116, Type III, 1/2 to 1-1/2 inches long.
 - 1. Available Products:
 - a. Fibrillated Fibers:
 - 1) Axim Concrete Technologies; Fibrasol F.
 - 2) FORTA Corporation; Forta.
 - 3) Euclid Chemical Company (The); Fiberstrand F.
 - 4) Grace, W. R. & Co.--Conn.; Grace Fibers.
 - 5) SI Concrete Systems; Fibermesh.

2.6 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.
 - 1. Available Products:
 - a. Axim Concrete Technologies; Cimfilm.
 - b. Burke by Edeco; BurkeFilm.
 - c. ChemMasters; Spray-Film.
 - d. Conspec Marketing & Manufacturing Co., Inc.; Aquafilm.
 - e. Dayton Superior Corporation; Sure Film.
 - f. Euclid Chemical Company (The); Eucobar.
 - g. Kaufman Products, Inc.; Vapor Aid.
 - h. Lambert Corporation; Lambco Skin.
 - i. L&M Construction Chemicals, Inc.; E-Con.
 - j. MBT Protection and Repair, ChemRex Inc.; Confilm.
 - k. Meadows, W. R., Inc.; Sealtight Evapre.
 - l. Metalcrete Industries; Waterhold.
 - m. Nox-Crete Products Group, Kinsman Corporation; Monofilm.
 - n. Sika Corporation, Inc.; SikaFilm.
 - o. Symons Corporation; Finishing Aid.
 - p. Vexcon Chemicals, Inc.; Certi-Vex EnvioAssist.
- E. White Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B.
 - 1. Available Products:
 - a. Anti-Hydro International, Inc.; AH Curing Compound #2 WP WB.

- b. Burke by Edoco; Resin Emulsion White.
- c. ChemMasters; Safe-Cure 2000.
- d. Conspec Marketing & Manufacturing Co., Inc.; W.B. Resin Cure.
- e. Dayton Superior Corporation; Day-Chem White Pigmented Cure (J-10-W).
- f. Euclid Chemical Company (The); Kurez VOX White Pigmented.
- g. Kaufman Products, Inc.; Thinfilm 450.
- h. Lambert Corporation; Aqua Kure-White.
- i. L&M Construction Chemicals, Inc.; L&M Cure R-2.
- j. Meadows, W. R., Inc.; 1200-White.
- k. Symons Corporation; Resi-Chem White.
- l. Tamms Industries, Inc.; Horncure 200-W.
- m. Unitex; Hydro White.
- n. Vexcon Chemicals, Inc.; Certi-Vex Enviocure White 100.

2.7 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.
- B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to requirements, and as follows:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- D. Chemical Surface Retarder: (For exposed aggregate concrete) Water-soluble, liquid-set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch.
 - 1. Products:
 - a. Burke by Edeco; True Etch Surface Retarder.
 - b. ChemMasters; Exposee.
 - c. Conspec Marketing & Manufacturing Co., Inc.; Delay S.
 - d. Euclid Chemical Company (The); Surface Retarder S.
 - e. Kaufman Products, Inc.; Expose.
 - f. Metalcrete Industries; Surfard.
 - g. Nox-Crete Products Group, Kinsman Corporation; Crete-Nox TA.
 - h. Scofield, L. M. Company; Lithotex.
 - i. Sika Corporation, Inc.; Rugasol-S.
 - j. Vexcon Chemicals, Inc.; Certi-Vex Envioset.

2.8 WHEEL STOPS

- A. Wheel Stops: Solid, 3000 PSI concrete, precast.
 - 1. Dowels: Galvanized steel, 3/4-inch diameter, 10-inch minimum length.

2.9 ADA TRUNCATED DOMES

- A. General: In-line replacable designed to be installed in a “wet set” condition. Units must include anchors which allow replacement by removing colored covers and bolts while leaving anchors in place.
- B. Materials: Homogenous glass and carbon reinforced composite
 - 1. UV stable and colorfast.
 - 2. Resistant to salt and chemical staining per ASTM B 117 & 1308.
 - 3. Minimum Compressive and Tensile Strength of 28,900 psi and 11,600 psi respectively.
 - 4. Must be able to handle load bearing capacity of 16,000 lbs per AASHTO –H20 with no visible damage.
 - 5. Color must be uniform throughout with no paint or coating to provide color.
 - 6. Dome geometry must comply with ADA regulations for detectable warnings at curb ramps in diameter, height and spacing.
- C. Where installation on radius is shown, provide precut and scored units for installation without gaps and piecemeal infills. Field cut rectangular units will not be acceptable.
- D. Units shall be by ADA Solutions, Inc. or approved equal.

2.10 CONCRETE MIXTURES

- A. The concrete mix used in performing this work shall be DeIDOT Class “A” or DeIDOT Class “B” depending on the compressive strength shown on the details and shall meet the approval of the Owner.
- B. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs for the trial batch method.
- C. Proportion mixtures to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 4000 psi or 3000 psi. depending on location
 - 2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.50.
 - 3. Slump Limit: 2-5, plus or minus 1 inch.
- D. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
 - 1. Air Content: 6 percent plus or minus 1.5 percent for 1-inch nominal maximum aggregate size.
- E. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- F. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture, plasticizing and retarding admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
- G. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements for concrete exposed to deicing chemicals. Limits shall be as follows per DelDOT requirements:
1. Fly Ash or Pozzolan: 25 percent.
 2. Ground Granulated Blast-Furnace Slag: 50 percent.
 3. Combined Fly Ash or Pozzolan, and Ground Granulated Blast-Furnace Slag: 50 percent, with fly ash or pozzolan not exceeding 25 percent.
- H. Synthetic Fiber: Uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd..

2.11 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116 where synthetic fibers are noted on the plans. Furnish batch certificates for each batch discharged and used in the Work.
1. When air temperature is between 85 deg F and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

2.12 PAVEMENT MARKINGS

- A. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248, Type N; colors complying with FS TT-P-1952.
1. Color: As indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.
1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
 2. Proof-roll with a loaded 10-wheel tandem-axle dump truck weighing not less than 15 tons.
 3. Subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch require correction according to requirements in Division 31 Section "Earth Moving."

- C. Proceed with concrete pavement operations only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

3.2 PREPARATION

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

3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.5 JOINTS

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

4. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
1. Locate expansion joints at intervals of 20 feet, unless otherwise indicated.
 2. Extend joint fillers full width and depth of joint.
 3. All Isolation Joints shall be treated with joint filler.
 4. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface.
 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 6. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. For larger walkways, width greater than 12' and plazas, submit shop drawing of joint pattern. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 3/8-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
 2. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.
- E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 3/8-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to fresh concrete after testing.

- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.
- H. Screed pavement surfaces with a straightedge and strike off.
- I. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- J. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not approved, remove and replace with formed concrete.
- K. Slip-Form Pavers: When automatic machine placement is used for pavement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce pavement to required thickness, lines, grades, finish, and jointing as required for formed pavement.
 - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of paver machine during operations.
- L. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.
- M. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 - 2. Do not use frozen materials or materials containing ice or snow.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mix designs.
- N. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
 - 1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

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

3.7 FLOAT FINISHING

- A. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
 1. Construct test sections of each type of concrete paving, including at least one expansion joint and control joints, for review by Owner for agreement of finish prior to starting concrete installation. Review will include texture of broom finish, joint striking, picture framing and geometric conformity.
 2. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
 3. Incorporate “picture framing” of concrete in finish within lump sum prices bid.

3.8 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:
 1. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 2. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.9 PAVEMENT TOLERANCES

A. Comply with tolerances of ACI 117 and as follows:

1. Elevation: 1/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-foot- long, unlevelled straightedge not to exceed 1/4 inch.
4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches.
8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.10 WHEEL STOPS

- #### A. Securely attach wheel stops into pavement with not less than two galvanized steel dowels embedded in holes drilled or cast into wheel stops at one-quarter to one-third points. Firmly bond each dowel to wheel stop and to pavement. Securely install dowels into pavement and bond to wheel stop. Recess head of dowel beneath top of wheel stop.

3.11 FIELD QUALITY CONTROL

- #### A. Testing Agency: Construction Manager shall engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

- #### B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least 1 composite sample for each 100 cu. yd. or fraction thereof of each concrete mix placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test 1 specimen at 7 days and 2 specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days.

- C. Strength of each concrete mix will be satisfactory if average of any 3 consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- D. Test results shall be reported in writing to Owner, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Owner but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Owner.
- G. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.12 REPAIRS AND PROTECTION

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

END OF SECTION 033030

SECTION 033073 - CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Expansion and contraction joints within cement concrete pavement.
- B. Related Sections include the following:
 - 1. Division 03 Section "Concrete Paving" for constructing joints in concrete pavement.

1.3 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.5 REQUIREMENTS

- A. Work within Town of Ocean View R.O.W. shall comply with Town of Ocean View Standards and Specifications.
- B. Work within DeIDOT R.O.W. shall comply with the Delaware Standard Specifications for Road and Bridge Construction August 2001, including all updates.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.7 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.2 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.

2.3 COLD-APPLIED JOINT SEALANTS

- A. Type NS Silicone Sealant for Concrete: Single-component, low-modulus, neutral-curing, nonsag silicone sealant complying with ASTM D 5893 for Type NS.
1. Products:
 - a. Crafcro Inc.; RoadSaver Silicone.
 - b. Dow Corning Corporation; 888.

2.4 JOINT-SEALANT BACKER MATERIALS

- A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.
- B. Round Backer Rods for Cold-Applied Sealants: ASTM D 5249, Type 3, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

- 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

3.3 INSTALLATION OF JOINT SEALANTS

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

- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

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

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

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

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

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

- 1. Remove excess sealants from surfaces adjacent to joint.
 - 2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

- F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions, unless otherwise indicated.

- G. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

3.4 CLEANING

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

3.5 PROTECTION

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

END OF SECTION 033073

SECTION 033100 – ARTICULATING PERMEABLE CONCRETE ROADWAY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. The structural and infiltrative capacity of the product type specified in this section, and utilized in the Town Road Trailhead parking, is integral to the design and permitted approvals of this application. Physical characteristics of this product; including, strength and subgrade requirements, permeability to precipitation and rain water storage, form integral components of the structural integrity and stormwater performance of this project application.
- B. The Contractor shall confirm, to Owner's satisfaction, proposed alternatives meet or exceed the design performance and conformance with approved Sediment and Stormwater Plan Approval, Ocean View approval and other project requirements.

- C. Related Sections include the following:

- 1. Division 03 Sections and Division 31 Sections, all.

1.3 SUBMITTALS

- A. Product Data:

- 1. The contractor shall submit to the engineer all manufacturer's performance research results and calculations in support of the permeable articulating concrete system, including geotextile, subcase, any underdrain system components identified and base materials.
- B. If alternative product use is requested, Contractor shall confirm compliance with design and permitting requirements and provide certification of approval from DNREC and Ocean View permitting authorities.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain permeable surface components from single manufacturer and other associated components from suppliers approved by permeable surface manufacturer.

1.5 REQUIREMENTS

- A. Infiltration Performance:

- 1. The system will only be accepted when accompanied by documented third party surface infiltration performance characteristics based on ASTM C1701/C1701M-09.

The surface infiltration rate shall be no less than 4,000 inches per hour on an outdoor working surface, with typical base material utilized for the test.

B. Structural Performance:

1. The design of the P-ACB/M shall be capable of supporting AASHTO HS-20 and H-20 truck loading. The blocks should be analyzed as unreinforced concrete arches supporting a uniform truck tire load with impact per AASHTO standards. Subgrade soil, geosynthetic and base preparation for the system must be properly prepared.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. This Section includes the following:

1. Permeable Articulating Concrete Block/Mats (P-ACB/M) in accordance with the fines, grades, design and dimensions shown on the Contract Drawings and as specified herein.
 - a. Product shall PaveDrain, Pavedrain, LLC, Milwaukee, WI or approved equal.

2.2 MATERIALS GENERAL

- A. Permeable articulating concrete block/mats shall be premanufactured of individual concrete blocks with specific stormwater runoff capacities, bound into mats by the use of revetment cables. The mats shall arrive at the jobsite assembled according to lengths and widths as specified on the approved shop drawings.
- B. Individual blocks in the articulating concrete mats shall be staggered, beveled, and interlocked for enhanced stability. The mats shall be constructed of closed cell blocks with an arched storage chamber for additional stormwater runoff as shown on the contract drawings. Parallel strands of cable shall extend through two (2) ducts in each block in a manner which provides for longitudinal binding of the blocks within the mats. Each row of blocks shall be laterally offset by one-half block width from the adjacent row so that any given block is cabled to four other blocks (two in the row above and two in the row below). Six adjacent blocks shall also surround each block.
- C. Each block shall incorporate interlocking surfaces that prevent lateral displacement of the blocks within the mats when they are lifted by the longitudinal revetment cables. The interlocking surfaces must not protrude beyond the perimeter of the blocks to such an extent that they reduce the flexibility or articulating capability of the articulating concrete mats or become damaged or broken when the mats are lifted during shipment or placement. Once the mats are in place, the interlocking surfaces and designed spacers on the sides of the individual blocks shall prevent the lateral displacement of the blocks even if the cables should become damaged or removed. The mats must be able to flex a minimum of 10 degrees between any given row and column of blocks in the uplift direction.

- D. The cables shall be inserted into the mats in such a manner to form lifting loops at each end of the mat with the corresponding cable ends spliced together to form lifting loops at the other end of the mat with sleeves approved by the engineer.
- E. Cellular Concrete Blocks - Materials shall conform to the following applicable ASTM specifications:
 - 1. Portland Cements - Specification C 150, for Portland Cement.
 - 2. Blended Cements - Specification C 595, for Blended Hydraulic Cements.
 - 3. Hydrated Lime Types - Specification C 207, for Hydrated Lime Types.
 - 4. Pozzolans - Specifications C 618, for Fly Ash and Raw or Calcinated Natural
 - 5. Pozzolans for use in Portland Cement Concrete.
 - 6. Aggregates shall conform to the following ASTM specifications, except that grading requirements shall not necessarily apply:
 - 7. Normal Weight - Specification C 33, for Concrete Aggregates.
 - 8. Cellular Concrete Blocks; Physical Requirements:
- F. Cellular Concrete Blocks - Physical Characteristics:
 - 1. Compressive Strength (average of 3 units)
 - 2. Min. psi = 4,000, mpa = 27.6
 - 3. Water Absorption (average of 3 units)
 - 4. Max. lb/ft³ = 10, kg/m³ = 160
- G. Visual Inspection:
- H. All units shall be sound and free of defects that would interfere with the proper placing of the unit or impair the strength or permanence of the construction. Surface cracks incidental to the usual methods of manufacture, or surface chipping resulting from customary methods of handling in shipment and delivery, shall not be deemed grounds for rejection.
- I. Cracks exceeding 0.25 inches in width and/or 1.0 inch in depth shall be deemed grounds for rejection.
- J. Blocks rejected prior to delivery from the point of manufacture shall be replaced at the manufacturer's expense. Blocks rejected at the job site shall be replaced at the expense of the contractor.
- K. Expense of Tests
 - 1. Additional testing, other than that provided by the manufacturer, shall be borne by the Contractor.
- L. The PaveDrainR permeable articulating concrete block/mats shall have the following nominal characteristics as identified on the plans.

Class	Type	Block Weight lbs/ft ²	Block Length (in)	Block Width (in)	Block Height (in)	Storage Volume (in)
S6-45	Closed	45-49	12.0	12.0	5.65	1.0

- M. Revetment Cable and Fittings
- N. Polyester Revetment Cable and fittings. Revetment cable shall be constructed of high tenacity, low elongating, continuous filament polyester fibers. Cable shall consist of a core

construction comprised of parallel fibers contained within an outer jacket or cover. The weight of the parallel core shall be between 65% to 70% of the total weight of the cable. The revetment cable shall have the following physical characteristics listed below.

Nominal Cable Dia. / Circumference	Approximate Strength (Lbs)	Weight / 100 ft (lbs, range)
1/4" - 20mm	3,700	2.47 -2.74
5/16" - 27mm	7,000	3.99-4.42

- O. Polyester cable shall be determined by the supplier, based on the size of the mats to be placed.
- P. Elongation requirements specified below are based upon stabilized new, dry, cable. Stabilization refers to a process in which the cable is cycled fifty (50) times between a load corresponding to 200D2 and a load equal to 10%, 20%, or 30% of the cables approximate average breaking strength. Relevant elongation values are as shown in the table below. The tolerance on the values is + 5%.

	% Breaking Strength		
	10%	20%	30%
Permanent Elongation (working)	.07	1.8	2.6
Elastic Elongation	0.6	1.4	2.2
Total Stretch	1.3	3.2	4.8

- Q. The revetment cable shall exhibit good to excellent resistance to most concentrated acids, alkalis, and solvents. Cable shall be impervious to rot, mildew and degradation. The materials used in the construction of the cable shall not be affected by continuous immersion in stormwater runoff.
- R. Selection of cable and fittings shall be made in a manner that insures a safe design factor for mats being lifted form both ends, thereby forming a catenary. Revetment cable splicing fittings shall be selected so that the resultant splice shall provide a minimum of 60% of the minimum rated cable strength. Fittings such as sleeves and stops shall be aluminum.
- S. Size of Permeable Articulating Concrete Block/Mats:
 - 1. The size of the permeable articulating concrete block/mats will be determined prior to the shipment of the materials from the manufacturer or another approved location into mats with a width of up to eight (8) feet and a length of up to thirty-six (36) feet or approved by the Engineer and or Owner.

PART 3 - EXECUTION

3.1 FOUNDATION AND PREPARATION:

- A. General. Areas on which permeable articulating concrete block/mats are to be placed shall be constructed to the lines and grades shown on the Contract Drawings and to the tolerances specified in the Contract Documents, and approved by the Engineer.
- B. Grading. The aggregate bedding layer shall be graded to a smooth plane surface to ensure intimate contact is achieved between the legs of the permeable articulating concrete block/mats and the aggregate bedding layer.
- C. Inspection. Immediately prior to placing the permeable articulating concrete block/ mats the prepared area shall be inspected by the Engineer, the owner's representative, And or by the manufacturer's representative. No blocks/mats shall be placed thereon until that area has been approved by one of these parties.

3.2 PLACEMENT OF PERMEABLE ARTICULATING CONCRETE BLOCKS/MATS

- 1. General. Permeable articulating concrete clock/mats, shall be constructed within the specified lines and grades shown on the contract drawings.
- 2. Placement. The permeable articulating concrete block/mats shall be placed on the aggregate bedding layer so as to produce a smooth plane surface. No individual block within the plane of placed permeable articulating concrete block/mats shall protrude more than one-quarter inch of an inch or as otherwise specified by the Engineer.
- 3. If installed in mats the permeable articulating concrete block/mats shall be attached to a spreader bar or other conventional device to aid in the lifting and placing of the mats in their proper position by the use of a crane or other approved equipment. The equipment used should be adequate capacity to place the mats without bumping, dragging, or otherwise damaging the aggregate bedding layer. The mats shall be “zippered” together forming a seamless mat to mat connection.
- 4. Consultation. Contractor to account for the cost and coordination to be supplied by the manufacturer of the permeable articulating concrete blocks/mats system. Manufacturer shall provide design and construction advice during the design and installation phases of the project.
- 5. Finishing. The joints between the P-ACB/M do not require backfilling with smaller aggregates or sand in order to function properly. The joints are meant to be left open.

3.3 CLEANING

- A. Contractor to keep material from entering openings in system and to vacuum truck the permeable area as a condition of final acceptance.

1.0 SCOPE

This specification covers the pre-fabricated concrete flush toilet building. The Cortez model, as produced by CXT Incorporated, has been used as the basis for design.

This specification includes optional equipment, based upon the basis of design – CXT productions Cortez restroom, required by the owner.

2.0 SPECIFICATIONS

ASTM C33	Concrete Aggregates
ASTM C39	Method of Test for Compressive Strength of Cylindrical Concrete Specimens
ASTM C94	Standard Specification for Ready-Mixed Concrete
ASTM C143	Method of Test for Slump of Concrete
ASTM C150	Standard Specification for Portland Cement
ASTM A185	Standard Specification for Steel Welded Wire Reinforcement, Plain, or Concrete
ASTM C192	Method of Making and Curing Test Specimens in the Laboratory
ASTM C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C309	Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C494	Standard Specification for Chemical Admixtures for Concrete
ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C979	Standard Specification for Pigments for Integrally Colored Concrete
ACI 211.1	Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 306	Cold Weather Concreting
ACI 318	Building Code Requirements Structural Concrete and Commentary (includes Errata)
PCI MNL 116	Quality Control for Plants and Production of Precast Prestressed Concrete Products

3.0 MANUFACTURER CRITERIA

The manufacturer supplying the requested precast concrete flush facility must meet the following:

- A. Manufacturer must be ISO 9001 certified at the time of bid.
- B. Manufacturing plant must be PCI certified at the time of bid.
- C. Manufacturer must not have defaulted on any contract within the last five years.
- D. Manufacturer must provide stamped, engineered drawings prior to acceptance.
- E. Manufacturer must be pre-approved during the bidding process by the owner.
- F. Manufacturer must show four examples of precast concrete flush facilities produced, installed and in use as an example of their ability to perform this contract.
- G. Manufacture shall provide a 20 year warranty.

4.0 DESIGN CRITERIA

Design criteria include 2006 IBC Code, 2006 IPC, 2008 NEC.

- A. **Roof Snow Load**
 - 1. Designed to withstand a 250 pounds per square foot snow load
- B. **Floor Load**
 - 1. Designed to withstand 400 pounds per square foot floor load
- C. **Wind Load**
 - 1. Designed to withstand the effects of 150 mile per hour (3-second gust) wind exposure C
- D. **Earthquake**
 - 1. Designed to withstand the effects of a seismic group 1 design category E earthquake.
- E. **Additional Design Standards**
 - 1. Designed to meet the requirements of the sixty-inch turning radius inside toilet room specified by the American with Disabilities Act Requirements and Uniform Federal Accessibility Standards as of the date of these specifications.
 - 2. Design shall use a concrete design with a minimum 3/12 roof pitch.

3. Shall have a minimum 4 inch wall, 4 ½ inch roof, and 5 inch floor thickness.
4. All wall to floor interior surface seams shall have a minimum 1” radius coving made of high strength grout.

5.0 MATERIALS

A. Concrete - General

The concrete mix design will be designed to ACI 211.1 to produce concrete of good workability.

1. Concrete will contain a minimum of 675 pounds of cementitious material per yard. Cement will be a low alkali type I/II or III conforming to ASTM C-150
2. Coarse aggregates used in the concrete mix design will conform to ASTM C33 with the designated size of coarse aggregate #67.
3. Minimum water/cement ratio will not exceed .45.
4. Air-entraining admixtures will conform to ASTM C260. Water reducing admixtures will conform to ASTM C494, Type A.
5. If Self Compacting Concrete (SCC) is used, it must conform to ASTM C1611

B. Colored Concrete

1. A 12”x12”x1” color sample will be available for customer approval. Color additives will conform to ASTM C979.
2. The following will contain colored concrete:
 - a. Toilet building roof panels
 - b. Building walls
 - c. Screen panels
3. The same brand and type of color additive will be used throughout the manufacturing process.
4. All ingredients will be weighed and the mixing operation will be adequate to ensure uniform dispersion of the color.

C. Cold Weather Concrete

1. Cold weather concrete placement will be in accordance with ACI 306.
2. Concrete will not be placed if ambient temperature is expected to be below 35 degrees F. during the curing period unless heat is readily available to maintain the surface temperature of the concrete at least 45 degrees F.

3. Materials containing frost or lumps of frozen materials will not be used.

D. Hot Weather Concrete

The temperature of the concrete will not exceed 95 degrees F. at the time of placement. When the ambient reaches 90 degrees F. the concrete will be protected with moist covering.

E. Concrete Reinforcement

1. All reinforcing steel will conform to ASTM A615. All welded wire fabric will conform to ASTM A185.
2. All reinforcement will be new, free of dirt, oil, paint, grease, loose mill scale and loose or thick rust when placed.
3. Details not shown of drawings or specified will be to ACI318.
4. Steel reinforcement will be centered in the cross-sectional area of the walls and will have at least 1 1/4" of cover on the under surface of the floor.
5. The maximum allowable variation for center-center spacing of reinforcing steel will be 1/2".
6. Full lengths of reinforcing steel will be used when possible. When splices are necessary on long runs, splices will be alternated from opposite sides of the components for adjacent steel bars. Lap bars #4 or smaller a minimum of 12". Lap bars larger than #4 a minimum of 24 bar diameters.
7. Reinforcing bars will be bent cold. No bars partially embedded in concrete will be field bent unless approved by the customer.

F. Sealers and Curing Compounds

1. Curing compounds, if used, will be colorless, complying with ASTM C309, type I or 1-D.
2. Weatherproofing sealer for exterior of building will be a clear water repellent penetrating sealer.

G. Caulking, Grout, Adhesive and Sealer

1. Caulking service temperatures from -40 to +194 degrees Fahrenheit.
2. Interior and exterior joints will be caulked with a paintable polyurethane sealant.
3. Grout will be a non-shrink type and will be painted to match the color of surrounding concrete as nearly as possible.
4. Cement base coating is formulated with a very fine aggregate system and is a built in bonding agent.

H. Paint

1. All paints and materials will conform to all Federal specifications or be similar “top-of-the-line-components”. Paints will not contain more than .06 percent by weight of lead.
2. Type of paints for toilets
 - a. Inside concrete surfaces
 - I Interior floors will be a chemical resistant urethane. The color will be gray.
 - II Interior walls and ceilings will be a modified acrylic, water repellent penetrating stain. The color will be white followed by a clear acrylic anti-graffiti sealer.
 - b. Metal surfaces both inside and out
 - I DTM ALKYD
 - c. Exterior concrete surfaces
 - I Exterior slab will be clear sealer
 - II Exterior walls and roof will be a water repellent penetrating stain in the same color as the walls or roof followed by a clear acrylic anti-graffiti sealer

I. Grab bars

Grab bars will be 18 gauge, type 304 stainless steel with 1-1/2” clearance. Grab bars will each be able to withstand 300 pound top loading.

J. Toilet Paper Dispenser

Dispenser will be constructed of 1/4” thick, type 304 stainless steel. Dispenser will be capable of holding three (3) standard rolls of toilet paper. Toilet paper holder fastening system will be able to withstand 300 pound top loading.

K. Steel Doors (if specified)

1. Doors will be flush panel type 1-3/4” thick, minimum 16 gauge Galvanized steel, top painted with DTM ALKYD.
2. Door frames will be knockdown or welded type, single rabbet, minimum 16 gauge prime coated steel top painted with DTM ALKYD, width to suit wall thickness. Three (3) rubber door silencers will be provided on latch side of frame.

L. Door Hinges

1. Door hinges will be 3 per door with dull chrome plating 4-1/2”x4-1/2”, adjustable tension, automatic-closing for each door.
2. Optional Stainless Steel Hinges

M. Lockset

1. Lockset will meet ANSI A156.2 Series 4000, Grade 1 cylindrical lockset for exterior door.
2. U.S. 26D finish.

N. Dead Bolt

Deadbolt will be a Lori Lock standard model with a double cylinder, 2 ¾” backset, and US26D finish. The cylinder will be a standard 1 1/8” Schlage Mortise cylinder with compression ring and 626 finish.

O. Door Stop

Doorstop will be a dome style stop meeting ANSI 156.16.

P. Double Coat Hook

Coat hook will be 304 stainless steel 16 gauge (1.5mm), formed construction with a satin finish and have 3/16”x 7/8” nail in anchor. Upper hook will extend at least 2-1/2” inches from the wall. Lower hook will extend at least 1-1/4” from the wall.

Q. Door Sweep

Door sweep will be provided at the bottom of door and will be an adjustable brush type.

R. Wall Vent

Wall vent will be crank operated allowing the unit to be opened or closed. Crank will be removable. Vent cover will be 14 gauge 304 stainless steel painted with DTM and anchored into the concrete wall with high strength anti-rust tap con fasteners. Vent to come with insect screen. Cover to be recessed a minimum ¾” on exterior walls with a 45 degree bevel. Interior to be flush mounted. Wall vent will not protrude from the wall.

S. Signs

1. Signs to have raised pictograms, letters and Braille to meet ADA.
2. All signs inset a minimum of 3/4" into wall with 45 degree bevel.
3. All signs to be anchored into concrete with 1/4" x 3/4" concrete anchor nails.

T. Windows

1. Window frames will be constructed from steel.
2. Window glazing will be 3/16" thick translucent pebble finished mar-resistant Lexan.
3. Windows to have 3/4" recess with 45 degree bevel.
4. Window frames to have vandal resistant fasteners.

U. Plumbing

1. All fixtures to meet ANSI A112.19.2
2. Waste and vent material will be ABS or PVC plastic and will be plumbed to meet Uniform Building Codes.
3. Water material will be copper tubing Type L, hard drawn. A gate valve will be provided at the inlet end of the water line. All water lines will be of a size to provide proper flushing action based on a nominal water pressure of 40 psi.
4. All plumbing will be concealed in the service area.
5. Toilet will be constructed of vitreous china, wall hung, with siphon jet action. Toilet will have a back spud for a concealed flush valve connection and will be mounted with the top of the seat 18 inches above the finished floor. Seat will be heavy duty solid plastic with an open front. Optional stainless steel fixtures available.
6. Flush valve will be concealed closet flush-o-meter constructed of rough brass. Furnish valve with integral vacuum breaker and wall mounted push button. Valve will be of a water saver type with a flow of 1.6 gallons per flush.
7. Lavatory will be vitreous china with back splashguard, front overflow opening, equipped with brass trap and drainpipe without stopper. Sink will be 20 inches wide x 18 inches front to back x 5 3/4 inches deep with ADA trap cover. Optional stainless steel fixtures available.
8. Water valve will be self-closing water set with indexed push button.
9. Hose bib available in the chase area.
10. A main shut-off valve and drain will be provided with plumbing.
11. Hammer arrester to be installed on water line.
12. Trap primer distribution unit shall be installed.
13. Optional Instant-Flow tankless electric water heater. Temperature rise of 75 degrees at .5gpm with a temperature preset of 104 degrees.

V. Electrical

1. All components UL listed
2. All electrical wiring will be in conduit, surface mounted in the service area and concealed in the user compartments. All wire will be copper.
3. A 100-amp NEMA 3R breaker panel will be provided and must be mounted on the exterior of the building to meet electrical code.
4. The chase area will have, cast in both common walls, lexan windows to allow light into each toilet room with one (1) 4-foot 3 bulb ceiling mounted low temperature ballast light fixture.
5. 2 exterior 35-watt High Pressure Sodium lights, polycarbonate vandal resistant.
6. The optional hand dryer is an air compression type with remote motor unit. Push button switch located in cast nozzle housing with flexible hose connecting blower motor, housing and nozzle. Power input 120VAC, 7A (non-heated air).
7. Two restroom area exhaust fans HVI certified, with 270 CFM speed controlled (control in chase area)
8. Lighting on the exterior of building will be photocell activated; interior will be motion activated; override switch in chase/utility room.

W. Optional Equipment to be provided:

1. Horizontal Lap Siding, (Color picked by Owner)
2. Delta Rib Roof, (Color picked by Owner)
3. Fiberglass Entry and Chase Doors and Frames
4. Magnetic Door Lock System with lock timer.
5. Sanitary Napkin Disposal
6. CXT Wastebasket
7. Paint Touch Up Kit – Two Tone
8. Hot water heater
9. LED Interior Lighting
10. Unit Heaters (for year round restroom use)
11. Stainless Steel door hinges, all doors.

6.0 MANUFACTURE**A. Mixing and Delivery of Concrete**

Mixing and delivery of concrete will be in accordance with ASTM C94, section 10.6 through 10.9 with the following additions:

1. Aggregate and water will be adjusted to compensate for differences in the saturated surface-dry condition.

B. Placing and Consolidating Concrete

Concrete will be consolidated by the use of mechanical vibrators. Vibration will be sufficient to accomplish compaction but not to the point that segregation occurs.

C. Finishing Concrete

1. Interior floor and exterior slabs will be floated and troweled.
2. All exterior building walls and exterior screen walls will be any one of the available textures.
3. All exterior surfaces of the roof panels will be cast to simulate any one of the available textures. The underside of the overhang will have a smooth finish.

D. Cracks and Patching

1. Cracks in concrete components which are judged to affect the structural integrity of the building will be rejected.
2. Small holes, depressions and air voids will be patched with a suitable material. The patch will match the finish and texture of the surrounding surface.
3. Patching will not be allowed on defective areas if the structural integrity of the building is affected.

E. Curing and Hardening Concrete

1. Concrete surfaces will not be allowed to dry out from exposure to hot, dry weather during initial curing period.

7.0 FINISHING AND FABRICATION

A. Structural Joints

1. Wall components will be joined together with two welded plate pairs at each joint. Each weld plate will be 6” long and located one pair in the top quarter and one pair in the bottom quarter of the seam. Weld plates will be anchored into the concrete panel and welded together with a continuous weld. The inside seams will be a paintable caulk. The outside seams will use a caulk in a coordinating building color or clear.
2. Walls and roof will be joined with weld plates, 3"x6" at each building corner.
3. The joint between the floor slab and walls will be joined with a grout mixture on the inside, a matching colored caulk on the outside and two weld plates 6” long per wall.

B. Painting/Staining

1. An appropriate curing time will be allowed before paint is applied to concrete.
2. Some applications may require acid etching. A 30% solution of hydrochloric acid will be used, flushed with water and allowed to thoroughly air dry.
3. Painting will not be done outside in cold, frosty or damp weather.
4. Painting will not be done outside in winter unless the temperature is 50 degrees F. or higher.
5. Painting will not be done in dusty areas.
6. All surface voids to be filled prior to painting
7. Schedule of finishes
 - a. Inside concrete surfaces
 - I Inside floors will be 1 coat of 1-part water based chemical resistant urethane.
 - II Interior walls and ceilings will be 2 coats of a modified acrylic, water repellent penetrating stain, followed by 1 coat of clear sealer.
 - b. Metal surfaces both inside and out
 - I 2 coats of DTM ALKYD
 - c. Exterior concrete surfaces
 - I Exterior walls will be 2 coats of water repellent penetrating stain in the same color as the walls or roof followed by 1 coat of clear acrylic anti-graffiti sealer.
8. Color choices for all colored surfaces shall be made by Owner.

8.0 TESTING

The following tests will be performed on concrete used in the manufacture of toilets. All testing will be performed in PCI certified laboratories. Testing will only be performed by qualified individuals who have been certified ACI Technician Grade 1. Sampling will be in accordance with ASTM C172.

1. The air content of the concrete will be checked per ASTM C231 on the first batch of concrete. The air content will be in the range of 5.0% +/- 2.0%.
2. The compressive strength of the cylinders will be tested to ASTM C39. We will make one (1) cylinder for release, one (1) for 7-days and one (1) for 28-days. The release must be a minimum strength of 2500 psi, the 7-day must be a minimum of 4500 psi and the 28-day must be a minimum of 5000 psi.
3. A copy of all test reports will be available to the customer as soon as 28-day test results are available.

9.0 INSTALLATION**A. Scope of Work**

Work specified under this Section relates to the placement of the unit on prepared foundations.

B. Location

As identified in the contract documents.

C. Compacting

The bottom of the area must be compacted after it has been dug out. After the base has been placed, it must be compacted as well. The bearing of the soil and base should be a minimum of 1,500 pounds per square foot.

D. Base

After compacting the bottom of the area, a minimum of 6" of a compacted, ¾" minus material base of gravel (i.e. road base) should be placed for support, leveling and drainage purposes. The base also limits frost action. The base must be confined so as to prevent washout, erosion or any other undermining. Install per contract documents.

10.0 WARRANTY

Provide a manufacturer warranty against defects in material or workmanship for a period of twenty (20) years on all concrete components All other non-concrete components will carry a one (1) year warranty.

END OF SECTION

SECTION 133501 – ENGINEERED FRP COMPOSITE BRIDGES

1. GENERAL

1.1. Scope

1.1.1. All engineering design and related detailing of the bridge(s) shall be provided by the supplier. The design and detailing shall conform to the Applicable Codes and Standards listed in the section 2 of this document and shall comply with structural drawings/plans.

1.1.2. Bridge(s) and its attachments shall be fully fabricated by a qualified supplier as outlined in this document.

1.1.3. Supplier shall be responsible for the delivery of all bridge materials.

1.1.4. These specifications are for fully engineered clear span bridge(s) FRP Composite construction and shall be regarded as minimum standards for design and construction.

1.1. Suppliers

All bridges supplied are to be manufactured by:

E. T. Techtonics
P.O. Box 40060
Philadelphia, PA 19106

Suppliers other than those listed above may be used provided they meet all the criteria of this specification and are approved, in writing, no later than one week prior to the bid opening.

Documentation to ensure proposed substitution shall be in compliance with these specifications must be provided and shall include the following minimum criteria to be considered:

- Representative Design Calculations
- Representative Drawings
- Splicing and Erection Procedures
- Warranty Information
- Inspection and Maintenance Procedures

1.2. Qualified Suppliers

The bridge manufacturer shall have been in the business of design and fabrication of bridges for a minimum of five years and provide a list of five successful bridge projects, of similar construction, each of which has been in service at least three years. List the location, bridge size, owner and contact reference for each bridge.

2. APPLICABLE CODES AND STANDARDS

2.1. Governing Codes and Standards

- Bridge shall be designed in accordance with the AASHTO, Guide Specification for Design of Pedestrian Bridges, latest edition, where applicable and unless otherwise stated in section 3 & 4 of this document.

- National Design Specification for Wood Construction, ANSI NDS, latest edition
- American Wood Preservers Association Standards, latest edition.
- International Building Code 2012 Edition.

3. GENERAL FEATURES OF DESIGN

3.1. Span

Bridge span shall be as indicated on the drawings.

3.2. Width

Interior clear width of the bridge shall as indicated on the drawings.

3.3. System

3.3.1. Bridge shall be an FRP Composite truss bridge, as defined in the structural drawings and this specification, or similar in look and function. Style must be approved in accordance with section 1.1 of this specification.

3.3.2. The bridge may be spliced at locations selected by the manufacturer.

3.3.3. Bridge shall be designed utilizing a half through underhung truss configuration, where the underhung floor support system is rigidly connected to the truss verticals in order to provide stability to the top chord.

3.4. Camber

Bridge shall be cambered to offset the dead load deflection

3.5. Slope

Bridge shall be designed for abutments and/or piers constructed at the elevations indicated in the structural drawings/plans.

3.6. Deck

Wood decking to be 3 x 12 No. 2 Southern Yellow Pine treated according to the American Wood Preservers Bureau.

3.7. Hardware

3.7.1. Bolted connections shall be ASTM A307 hot dipped galvanized per ASTM A153.
Mounting devices shall be stainless steel.

3.7.2. Bridge shall include bearing pads, as recommended by the Manufacturer.

4. Engineering

4.1. Design Loads

4.1.1. Dead Load

The bridge shall be designed considering its own dead load including structure and decking (approximately 12,500 lbs.).

4.1.2. Pedestrian Live Load

Main supporting members, including trusses, primary beams, and arches shall be designed for a uniformly distributed load of 85 pounds per square foot plus vehicular load indicated below.

Secondary members, including deck and supporting floor system shall be designed for a live load of 85 pounds per square foot plus vehicular load indicated below.

4.1.3. Vehicle Load

The bridge shall be designed for an occasional 10,000 lb. vehicle loading, where 60% of the load is considered to act on the rear axle and 40% on the front. All floor beams and main supporting members shall be designed to support the vehicle load, uniformly distributed across their width at a maximum wheel base of 6 feet.

All deck members and stringers shall be designed for a concentrated load of 30% of the vehicle load, positioned to produce the maximum load effect.

4.1.4. Lateral Loads

4.1.4.1. Horizontal Wind Load

The Bridge shall be designed for a horizontal wind load of 35 lbs per square foot, applied to the full vertical projected area of the bridge as if enclosed, at right angles to the longitudinal axis of the structure. Wind loads shall be proportionally distributed across all exposed primary member surfaces including chords, vertical posts, and truss diagonals on the windward side.

Fatigue effects shall be considered for all load combinations incorporating wind loads, where $n=100,000$ cycles.

4.1.4.2. Overturning Wind Load

The effect of forces tending to overturn the structure shall be calculated assuming that the wind direction is at right angles to the longitudinal axis of the structure. In addition, an upward force shall be applied at the windward quarter point of the transverse superstructure width. This force shall be 20 pounds per square foot of deck influence area.

4.1.4.3. Seismic Load

Seismic loads shall be determined according to the criteria specified in the International Building Code unless otherwise requested.

4.1.5. Top Chord/Rail Load

The top chord, top rail, and vertical posts shall be designed for a simultaneous vertical and horizontal load of 50 pounds per linear foot or a 200 pound point load, whichever is greater, positioned to produce the maximum load effect.

4.1.6. Horizontal Rails

The picket system shall be designed for a 200 pound point load, applied transversely over an area of 1 square feet.

4.2. Design Limitations

4.2.1. Serviceability

Service loads shall be used for the design of all structural members when addressing deflection and vibration issues.

Deflection:

Live Load (LL) deflection = $L/240$

Vertical Frequency (fn) = 5.0 Hz

The fundamental frequency of the pedestrian bridge (in the vertical direction) without live load should be greater than 5.0 hertz (Hz) to avoid any issues with the first and second harmonics.

Horizontal Frequency (fn) = 3.0 Hz

The fundamental frequency of the pedestrian bridge (in the horizontal direction) without live load should be greater than 3.0 hertz (Hz) to avoid any issues due to the side to side motion involving the first and second harmonics.

4.2.2. Allowable Stresses

An Allowable Stress Design (ASD) approach shall be used for the design of all structural members. Factors of safety used in the design of FRP bridges shall be as follows unless otherwise specified: (Based on the Ultimate Strength of the FRP material)

Tension	2.5
Compression	2.5
Shear	2.5
Bending	2.5
End Bearing	2.5
Connections	3.0

4.2.3. Frame Stability

The buckling load factor for the bridge structure shall be no less than 4 for any combination of applied loads, to ensure adequate overall stability and stiffness.

4.3. Analysis

Full structural analyses for the primary bridge structure shall be completed. All analysis and results necessary to determine the structural adequacy of the bridge shall be reported. The following analyses are required:

4.3.1. Stress and Deflection

Analysis shall be completed to determine that all bridge members, critical connections, and bridge configurations are sufficient to adequately resist the following load combinations and in accordance with section 4.2 of this specification:

- Load Combination I – Dead Load + Pedestrian Live Load
- Load Combination II – Dead Load + Wind Loads
- Load Combination III – Dead Load + Vehicle loads
- Load Combination IV – Top Chord/Rail Load

4.3.2. Frame Stability

Buckling analysis shall be completed to determine that the bridge frame is adequately stable and sufficient to resist forces causing it to buckle for the following load combinations and in accordance with section 4.2 of this specification.

- Load Combination I – Dead Load + Pedestrian Live Load
- Load Combination II – Dead Load + Wind Loads
- Load Combination III – Dead Load + Vehicle loads

5. Materials

5.1. Structural Members

FRP bridges shall be fabricated from high-strength E-glass and isophthalic polyester resin unless otherwise specified.

Weathering and ultraviolet light protection shall be provided by addition of a veil to the laminate construction. Minimum material strengths and properties are as follows:

Tension	33,000 psi
Compression	33,000 psi
Shear	4,500 psi
Bending	33,000 psi
Young's Modulus	2,800,000 psi

The minimum thickness of FRP Composite shapes shall be as follows unless otherwise specified: Square tube members (closed type shape) shall be 0.25 in. Wide-flange beams, channel sections, and angles (open type shapes) shall be a minimum thickness of 0.25 in. Standard plate shall be a minimum thickness of 0.25 in.

5.2. Deck

Wood decking to be 3x12 No. 2 Southern Yellow Pine treated in accordance with the American Wood Preservers Bureau.

5.3. Bearing Pads

All bearing pads shall be as required.

6. Submittals

6.1. Fabrication drawings

Fabrication drawings and calculations shall be prepared and submitted for review after receipt of the order. Submittal drawings shall be unique drawings to this project, prepared to illustrate the specific portion of the bridge being fabricated. All relative design information such as member

size, material specification, and dimensions shall be clearly shown on the drawings. Drawings shall have cross referenced details and sheet numbers. All drawings shall be stamped, and signed by a Professional Engineer registered in the state of Delaware.

At minimum the following criteria must be included for approval:

- All Relevant Bridge Dimensions
- Bridge Cross sections
- Sufficient Detailing
- Member Cross sections
- General Notes indicating material specifications and design loads
- Detail of Bolted Splices (if applicable)
- Signature and Seal of PE licensed in accordance with this specification
- Camber Details

6.2. Calculations & Results

Structural analysis results and calculations shall be prepared and submitted for review after receipt of the order. All analysis and results necessary to determine the structural adequacy of the bridge shall be shown. All calculations shall be stamped, and signed by a Professional Engineer registered in the state of Delaware.

At minimum the following criteria must be included for approval:

- Bridge Reactions for all load combinations
- Expansion and Contraction Requirements and/or induced loads
- Bolted Splice Calculations (if applicable)
- Detailed Description of Applied Loads and Conditions for all load combinations
- Member maximum allowables for all load and design conditions
- Data Input
- Results and supplementary calculations for all Stress & Deflection Analyses
- Results for frame stability analysis.
- Results for frequency analysis.

7. Fabrication

7.1. Tolerances

All cutting and drilling fabrication to be done by experienced fiberglass workers using carbide or diamond-tipped tooling to a tolerance of 1/16". No material deviations beyond industry standards are accepted. All cut edges to be cleaned and sealed.

7.2. Finishing

Bridge color shall be determined by the Owner.

8. Delivery and Erection

8.1. Delivery

Delivery shall be made by truck to a location nearest the site accessible by roads. Bridges shall be shipped to the site in component parts or partially assembled depending on site requirements.

8.2. Erection

For bridges shipped in component parts or partially assembled, provide assembly drawings and a recommended assembly procedure for building the bridge, temporary supports or rigging equipment, if needed. For bridges shipped assembled advise the client of the actual lifting weights, attachment points and all necessary information to install the bridge.

9. Warranty

9.1.

Manufacturer shall warrant the structural integrity of all FRP materials, design and workmanship for 15 years.

SECTION 224000 - PLUMBING

PART 1 - GENERAL

1.1 INSTRUCTIONS

- A. All General and Special Conditions pertaining to the General Contract including all Addenda are part of this specification and this contractor shall consult them in detail for instructions pertaining to their work.
- B. Entire plumbing and drainage systems shall conform to International Plumbing Code, and any other local codes or authorities having jurisdiction.

1.2 SCOPE OF WORK

- A. The work under this section of the specification shall include all labor, materials, appliances and services necessary for and incidental to the proper completion of the plumbing and drainage systems for this structure and related work shown, implied or required by the drawings and/or described in the specification. This section addresses all plumbing work necessary to provide service to the proposed prefabricated restroom.
- B. Plumbing and drainage work for this building shall consist of:
 - 1. Provide a complete plumbing system including domestic hot and cold water, water and sewer service as indicated on the contract drawings. Connect piping to water and sanitary piping provided by the offsite utility providers.

1.3 TESTING, BALANCING AND ADJUSTING

- A. Testing to meet all municipal and utility provider requirements.
- B. Test procedures outlined here are a minimum requirement. If requirements of governing authorities or utility companies are more stringent, perform testing procedures as directed thereby. Remove or valve any appurtenances that are not capable of withstanding test pressure.
- C. Pressure test all piping systems as follows:
 - 1. All interior and exterior systems of soil, waste and vent:
 - a. Test with water unless weather conditions prevent so doing, in which case, use air.
 - b. 10'-0" minimum static head of water or 5 psig minimum air pressure must be maintained for sixty (60) minutes without drop of pressure.

- c. Test separately and prove tight before backfilling, entire system of underground piping between sewer connection and vertical penetration of building or grade.
 - d. All portions of interior piping may be tested in sections with necessary test tee connections.
 - e. Finally, test entire system from sewer connection to remotest and/or highest fixture.
- 2. Test all new domestic water services and interior systems of domestic piping to 100 psig, or system working pressure whichever is greater for a period of twelve (12) hours without drop in pressure.
 - 3. Test all new gravity sewers by plugging the end of the building sewer at the point of connection with the site sewer, filling the building sewer with water, testing with not less than 10 feet head of water and maintaining such pressure for a minimum of 60 minutes.
- D. Test, calibrate and adjust as required the following system components:
 - 1. Relief valve.
 - 2. Thermostatic mixing valve.
 - 3. Control sequence for domestic hot water heater.
 - 4. Backflow preventers; operation under system failure conditions.
 - E. Submit to the Architect all data required for conformance of the requirements of this Article.

1.4 AS-BUILT DRAWINGS

- A. As-built requirements shall include at minimum:
- B. Prepare red lined copies of contract drawings during the construction period, record drawings indicating the exact dimensioned location of all underground piping dimensioned from obvious and accessible data points, in addition to all above-ground piping and accessories.
- C. Provide a minimum of four (4) prints of each as-built drawing, in addition to originals and deliver to Architect. Originals are Owner's property.
- D. Contractor shall pay all costs associated with as-built drawings.

1.5 DATA SUBMITTAL REQUIREMENTS

- A. Data submittals shall include:
 - 1. MANUFACTURER'S & SUB-CONTRACTORS LIST

2. SHOP DRAWINGS

B. The items which shall be included on Manufacturers and Sub-Contractors List, and for which shop drawings are required shall include:

1. ARTICLE NAME (Where Used)

- a. Access Doors & Panels
- b. Piping
- c. Piping Valves
- d. Mixing Valve
- e. Relief Valves
- f. Insulation
- g. Disinfection of Domestic Water System
- h. Hot Water Heater
- i. Plumbing Fixtures
- j. Plumbing Specialties
- k. Backflow Preventers
- l. Pumps

PART 2 - MATERIAL, EQUIPMENT AND SYSTEMS

2.1 PIPING SYSTEMS

A. Piping and associated appurtenances shall be as specified by the Contract drawings and in compliance with Ocean View and Tidewater Utilities requirements.

2.2 VALVES

A. Valves shall be as specified by the Contract drawings and in compliance with Ocean View and Tidewater Utilities requirements.

2.3 SANITARY SYSTEM

A. Start work at point of connection 5'-0" outside building and work back toward building. Provide final connection as necessary to sanitary and storm sewers.

B. Make all changes in direction of underground pipe with wye branches and 1/8 bends. Install cleanouts at the end of wye branch fittings and extend to finished

grade or floor. Provide cleanouts at the base of all vents, stacks and rainwater conductors.

- C. The approximate position and size of all piping for these systems as shown generally on the drawings. Where question exists, consult with the Architect before proceeding with any work. The entire system must comply with latest edition of the International Plumbing Code.
- D. Provide test tees for sewers leaving the building and all other locations within the building to allow for complete and sectionalized testing.
- E. Extend vent, waste and soil stacks 24" minimum above roof structure or 24" above air intakes to any mechanical air moving equipment.
- F. Install sanitary drains at minimum slope to attain 3 feet per second flow or 1/4" per foot, unless noted otherwise.

2.4 DOMESTIC WATER SYSTEMS

- A. Contractor shall provide all necessary pipe valves, fittings and equipment required for completion of this installation.

2.5 DISINFECTION OF DOMESTIC WATER SYSTEM

- A. After satisfactory completion of all tests, the entire domestic water system shall be thoroughly flushed with water to remove sediment and then disinfected.
- B. Disinfection procedure shall be performed by an approved, certified Testing Laboratory. Contractor shall submit proposed Testing Laboratory to Architect for approval. This specification includes domestic cold, hot and hot water recirculation systems, equipment and fixtures, as needed to completed the proposed work. Isolate all adjacent buildings and systems during disinfection procedure.
- C. Plumbing Contractor shall provide all necessary valves for introduction of disinfection solution. Permanently cap or plug all valves after disinfecting procedure.
- D. The disinfecting procedure shall be as follows:
 - 1. The entire system shall be filled with a water solution containing at least 50 parts per million of available chlorine retained for a minimum of twenty-four (24) hours, or 200 parts per million for a minimum of three (3) hours. The system can be drained at the end of the retention period as long as there is no less than 10 parts per million of chlorine present at the extreme end of the system.
 - 2. After draining the system, it shall be thoroughly flushed and filled with fresh water. After test has determined that all traces of chlorine in excess of one part per million have been removed from water in system, system shall be returned to placed in service.

3. Sterilization and testing procedures shall comply with AWWA C651 or C652.
4. The Testing Laboratory shall certify to the Architect in writing the following:
 - a. Obtain water samples from the system for analysis by a certified Bacteriological Laboratory.
 - b. Test for the presence of coliform organisms. The entire sterilization procedure shall be repeated if any samples tested indicate the presence of coliform organisms.

2.6 DOMESTIC WATER HEATER

- A. Heater shall be provided and installed by the precast restroom manufacturer; model and capacity as noted on drawings.
- B. Provide drain valve and ASME approved T & P relief valves, piped to the nearest drain.

2.7 DOMESTIC HOT WATER EXPANSION TANK (DET-1)

- A. As needed, manufacturer shall provide a pre-charged, pneumatically cushioned, flexible butyl diaphragm type expansion tank. Steel tank, A.S.M.E. construction and stamped. Maximum working pressure, 150 psi and maximum working temperature 200 F. Vertical configuration.
- B. Pneumatic tire valve connection for recharging air.
- C. Internal wetted parts to comply with FDA regulations and approvals.
- D. To be 2.1 gallons total capacity, 0.43 maximum acceptance, factor.
- E. Amtrol, Inc. CT-C Therm-X-Trol Series, Model ST-5-C as standard of design and construction. Bell & Gossett, Watts or per-approved equivalents acceptable.

PART 3 - PLUMBING FIXTURES

3.1 GENERAL

- A. Provide all fixtures described herein or scheduled on the drawings.
- B. All trim shall be manufacturer's best grade, and all fixtures and trim shall be perfect in all respects.
- C. Except as noted, all faucets, fittings, traps, seat hinges, water and waste connections and any other exposed metal parts of fixtures or trim shall be polished chrome plated over nickel-plated brass.

- D. All lavatory and sink faucets and valves shall be of plain design with renewable bronze barrels which shall be removable from the fitting without disconnecting the body from the piping.
 - E. Securely bolt all carriers for water closets, urinals and lavatories with a minimum of 1/2" diameter bolts, utilizing all bolt holes in the foot of each carrier. All hangers and/or carriers should be designed specifically for the fixtures installed and as recommended by the fixture manufacturer. Where fixtures are supported from walls, provide 1/2" fixed steel backing plates.
 - F. Provide a separate trap whether fixture is installed under the General or Plumbing Contract. Provide cold water or hot and cold water connections at each fixture with a stop or valve for each supply to a fixture.
 - G. Protect all plumbing fixtures and trim during entire period of construction. Be responsible for all damage to fixtures and trim during construction and make good such damage as determined by the Architect without additional cost to the Owner.
 - H. Fixture figure numbers shall apply to the entire fixture as outlined in catalog or as required, including traps, supplies or any other trim. Where fixtures are provided under the General Contract, the Plumbing Contractor is still responsible for providing all traps, supplies or any other trim. If any number does not include the item as intended or modified in this specification, include the item as if it were mentioned, specified or shown.
- 3.2 STANDARD OF QUALITY
- A. Plumbing fixtures: American Standard, Kohler, Eljer, Crane, Bradley or Acorn.
 - B. Trim: Speakman, American Standard, Kohler, Delta or Moen.
 - C. Shower trim: Bradley, Leonard, MCC/Powers or Speakman.
 - D. Toilet seats: Church, Olsonite, American Standard, or Beneke.
 - E. Electric water cooler: Oasis, Halsey Taylor, Elkay, Haws or Sunroc.
 - F. Stainless steel sink: Just, Elkay or Kohler.
 - G. Flush valves: Sloan, Delany or Zurn.
 - H. Carriers: J. R. Smith, Josam, Ancon or Zurn.
 - I. Service Sink: Kohler, CES.
- 3.3 PLUMBING FIXTURES - DESCRIPTION
- A. Plumbing fixtures shall be as described in the fixture schedule on the drawings.

PART 4 - PLUMBING SPECIALTIES

4.1 MANUFACTURERS

- A. Josam as the standard of design and construction, with J.R. Smith, Ancon and Zurn equivalents acceptable.
- B. Model number listed for each item is Josam figure numbers, unless noted otherwise.

4.2 DRAINS

- A. Mechanical Room: Drains shall be two piece, coated cast iron body, round top type, double drainage flange and weepholes, non-clog slotted removable cast iron sediment bucket, removable 8-1/8" diameter cast iron chained loose-set non-tilt bar grating with perimeter drainage slots having 22 sq. in. free area, wedge lock non-puncturing flashing ring and clamps, 1/2" trap primer tapping, pipe size as indicated, for caulk, threaded, or no hub bottom outlet as required; Josam Series 32120, Smith, Zurn or approved substitute.
- B. Toilet Room: Drains shall be coated cast iron, two-piece body with double drainage flange, 3" outlet, 1/2" primer tapping, "Nikaloy" collar and 8" diameter 16.2 sq. in. free area strainer, fitted to deep seal cast iron trap below floor. Drains shall be set to receive flashing, Josam Series 30000-A, "Super-Flo", Smith, Zurn or approved substitute.

4.3 CONDUCTOR BOOTS

- A. Furnish and set for exterior rain water conductors where noted, cast iron conductor boots of design, size and height as required. Boots shall have cast offset lugs and be secured to wall with 1/2" galvanized expansion shields and galvanized iron bolts. Bottom of boots shall have 6" diameter offset outlet. Boots shall be Neenah R4925 series Barrycraft Construction Casting Co. or approved substitute.

4.4 TRAP SEAL PRIMER VALVE

- A. Floor drain and open waste drain traps shall have automatic water primers connected to nearest lavatory or sink fixture with 3/8" copper tubing extended under floor to body of floor drain. Primers shall be bronze or brass construction with integral vacuum breaker gasketed access cover and threaded connections. Provide adapters where required. Primers exposed in finished spaces shall be polished chromium plated; Josam 88250, Smith, Zurn, Chicago Faucet, Precision Plumbing Products or approved substitute.

4.5 TRAP PRIMER VALVE DISTRIBUTION UNIT

- A. When multiple floor drains are to be supplied from a single trap primer valve use Precision Plumbing Products, inc. trap primer distribution units with multiple outlets to suit the number of traps being served Trap Primer Valve Model P-1 to supply 3 to 8 traps or Trap Primer Valve P-2 to serve 1 or 2 traps as manufactured by Precision Plumbing Products, Inc. Valve to be supplied by a 1/2" cold water

supply. A ball valve is to be provided in the ½" water supply to the trap primer valve. Primer valve to be of corrosion resistant brass and be furnished w/mounting brackets. Install according to manufacturers specification.

4.6 CLEANOUTS

- A. Interior - Josam Series 58500, complete with coated cast iron body, flashing flange with flashing device and nickel bronze top.
 - 1. Unfinished areas - coated cast iron body, flashing flange with flashing device and polished bronze counter sunk threaded plug.
 - 2. Carpeted areas - floor access cover, with adjustable rug clamping frame, nickel bronze top, installed in conjunction with cast iron cleanout body with cast bronze plug.
- B. Stack type - J.R. Smith series #4530 or Josam Series 58510, with Series 58600 Wall Access Cover. Coated cast iron cleanout tee, with raised head bronze plug. Provide at the base of all vents, wastes, stacks and rainwater conductors. Provide cover as follows:
 - 1. Ceramic tile areas - All stainless steel with bolt length to match wall thickness.
 - 2. All other areas - Prime coated steel with bolt length to match wall thickness.
- C. Exterior - J.R. Smith figure # 4258, complete with anchor flange, cast iron construction with "CLEANOUT" inscribed on cover. Provide 6" thick x 18" square concrete support around anchor flange of body, upon installing.
- D. Install cleanouts where indicated and extend piping with connections to existing piping.

4.7 FLOOR CLEANOUT

- A. Josam Series 56010, 4" pipe size levelze floor cleanout. Coated cast iron body, inside caulk connection with internal gasketed ABS cleanout plug and adjustable ABS housing having a secured scoriated satin Nikaloy cover and round top. Zurn 1400-2, Smith 4031 or approved substitute.

4.8 INSTALLATION

- A. Provide all cutting and patching required for the installation of materials and equipment. Refer to Section 15010.
- B. Provide all excavation and backfill required for the installation of materials and equipment. Refer to Section 15010.
- C. Install floor drains and cleanouts where indicated and extend piping with connections to existing piping.

SECTION 311000 – SITE CLEARING & TREE PROTECTION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 1. Protecting existing trees. Shrubs, plants and grass to remain and trimming of existing trees that interfere with, or are affected by execution of the work, whether temporary or permanently during construction.
 2. Removing existing trees and other vegetation.
 3. Clearing and grubbing.
 4. Stripping and stockpiling topsoil.
 5. Removing above- and below-grade site improvements.
 6. Disconnecting, capping or sealing and abandoning site utilities in place and removing site utilities.
 7. Temporary erosion and sediment control measures.
- B. Related Sections include the following:
 1. Division 01 Section “Temporary Construction Utilities, Facilities & Controls” for temporary utilities, temporary construction and support facilities, temporary security and protection facilities.
 2. Division 31 Section “Earth Moving” for soil materials, excavating, backfilling and site grading.
 3. Division 32 Section “Turf and Grasses” for finish grading, including preparing and placing planting soil mixes and testing of topsoil materials.

1.3 DEFINITIONS

- A. Topsoil: Natural or cultivated surface soil layer containing organic matter and sand, silt and clay particles; friable, pervious and black or a darker shade of brown, grey or red than underlying subsoil; reasonably free from subsoil, clay lumps, gravel and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials or other non-soil materials.
- B. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.4 MATERIAL OWNERSHIP

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

1.5 SUBMITTALS

- A. Photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.

1.6 QUALITY ASSURANCE

- A. Pre-installation Conference: conduct conference: at Project site to comply with requirements in Division 1 Section "Project Management and Coordination".
 - 1. Before tree protection and trimming operations begin, meet with representatives of authorities having jurisdiction, Owner, Landscape Architect, consultants and other concerned entities to review tree protection and trimming procedures and responsibilities.
 - B. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed tree protection and trimming work similar to that required for this project and that will assign an experienced, qualified arborist to the project site during execution of tree protection and trimming.
 - C. Arborist Qualifications: an arborist certified by ISA or licensed in the jurisdiction where the project is located.
 - D. Tree Pruning Standard: comply with ANSI A300 (part 1), "Tree, Shrub and Other Woody Plant Maintenance – Standard Practices (pruning)."

1.7 PROJECT CONDITIONS

- A. Existing Conditions:
 - 1. Carefully examine the site before submitting a bid. Be informed of the site conditions including adjacent properties, utilities and soil conditions.
 - 2. Should the Contractor find any discrepancies between the drawings and physical conditions, inform the Owner's Representative and the Landscape Architect immediately for clarification.
- B. TRAFFIC: Minimize interference with adjoining roads, streets, walks or other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Utility Locator Service: Notify utility locator service for area where Project is located before clearing.

- D. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place and have been properly approved by the local sediment and erosion control agency.

PART 2 – PRODUCTS

2.1 SOIL MATERIALS

- A. Satisfactory Soil materials: Requirements for satisfactory soil materials are specified in Division 31 section “ Earth Moving”.
 - 1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on site.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Locate and clearly flag trees and vegetation to remain or to be relocated.
- C. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to the Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to approved Sediment and Erosion Control Drawings.
- B. Inspect, repair and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE PROTECTION

- A. protect all trees and other plant material scheduled to remain. Do not park any vehicles or equipment, store materials or stockpile soil , dispose of building materials, chemicals, petroleum products, or other detrimental substances, secure

- cable, chain or rope to trees or shrubs, apply soil sterilants under pavement near existing trees within limits of tree protection fencing or any existing tree to remain. Protect existing trees from flame, smoke and heat. Construction access to site shall not occur beneath drip line of existing trees until special provisions have been met to protect all existing vegetation to remain. The Contractor shall be responsible for all damage to the existing trees and plant material during construction.
- B. Root protection - protect all tree roots within the tree protection root zone. If tree roots are encountered during excavation for path, roots shall be cut with pruner or saw. Roots shall not be pulled out by excavator or other equipment.
 - C. Repair or Replant Trees and vegetation indicated to remain that area damaged by construction operations.
 - 1. Trees that are designated to remain, which become damaged or die, shall be reviewed by the Owner's Representative prior to tree replacement. Not including trees above 8" in caliper.
 - 2. If the contractor damages or destroys an existing tree, shrub and/or groundcover which he/she has been directed to preserve due to failure to comply with Specifications and Drawings, the contractor shall replace it with trees at twelve (12) foot height, shrubs at (24" height and groundcovers at (1) gallon containers spaced at 18" on center with same plant species, size and grade with a healthy tree and/or shrub acceptable to the Owner and the contractor shall guarantee that the tree, shrub and/or groundcover shall live for a period of (1) year from Owner's acceptance.
 - 3. the Owner shall charge the contractor damages to an existing tree (8") in caliper and larger, as measured 3' above the lowest grade immediately adjacent to the said tree. The Owner shall charge the contractor at the rate of \$100. per square inch of damaged area. The following are examples of damage to a tree above and below ground surface: scrapes and other abrasions penetrating to the cambium layer of the main or lateral stem, splits in the bark and between main stem and lateral stems, rips, shredding, gouges, cuts, avulsions of tree parts and dents. The calculated value of the significant tree, as described above shall be deducted from the contract amount. It is the Contractor's responsibility to notify the Owner immediately after damage has occurred.
 - 4. The Owner shall charge the Contractor the following rates for destroyed existing trees, which can not be replaced: \$100. per square inch of cross sectional areas measured 3-feet above the existing grade for trees up to and including 6" caliper; and at the rate of \$200. per square inch of cross sectional areas measured 3-feet above the existing grade for trees between 7" to 11" caliper. This amount shall be credited to the Owner.
 - 5. Remove any damaged and destroyed trees from the site. All trees are not to be removed unless evaluated by the Landscape Architect prior to begin cut down and removed from the site. Grub stumps 18" below grade and repair the ground surface . All costs shall be borne by the Contractor.

INSPECTIONS

A. Monthly inspections to monitor the effectiveness of the Tree Protection Plan will be done by the Owner's Representative. Report with conditions and recommendations will be provided after every inspection.

3.4 UTILITIES

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by the Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated.
1. Notify Engineer and Owner not less than five days in advance of proposed utility interruption.,
 2. Do not proceed with utility interruption without Construction manager's written permission
- B. Excavate for and remove underground utilities indicated to be removed. Refer to Sections covering site utilities.

3.5 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, grass and other vegetation to permit installation of new construction.
1. Do not remove trees and shrubs and other vegetation indicated to remain or to be relocated.
 2. Cut minor roots, branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
 3. Grind stumps and remove roots, obstructions and debris extending to a depth of 18 inches below exposed grade.
 4. If roots are encountered in the tree protection zones, roots shall be cut with a pruner or saw. Do not pull out with excavator or other equipment.
 5. Chip removed tree branches and dispose of off-site.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil materials unless further excavation or earthwork is indicated.
1. Place fill materials in horizontal layers not exceeding a loose depth of 8 inches and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.

- B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
 - 1. Remove subsoil and nonsoil materials from topsoil, including trash, debris, roots, weeds and other waste materials.

- C. Stockpile topsoil materials within approved stockpile locations away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Do not stockpile topsoil within tree protection zones.
 - 2. Stockpile surplus topsoil to allow for resspreading deeper topsoil.

3.7 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

3.8 DISPOSAL

- A. Disposal: remove surplus soil material, unsuitable topsoil, obstructions, demolished materials and waste materials, including trash and debris, and legally dispose of them off Owner's property.

SECTION 312000 – EARTH MOVING

PART 1 - GENERAL

1.1 RELATED WORK

- A. DIVISION 3 - CONCRETE, as placed on earth or fill.
- B. DIVISION 31 - SITE WORK, all other sections.
- C. DIVISION 32 – EXTERIOR IMPROVEMENTS, all sections
- D. DIVISION 33 – UTILITIES, all sections

1.2 RELATED DOCUMENTS

- A. The General Conditions, any Supplementary General Conditions and Division 1, General Requirements, are hereby made a part of this Section as fully as if repeated herein.

1.3 SECTION INCLUDES

- A. Earthwork includes areas below building foundations, below concrete slabs on grade, below paved areas and grading of all unpaved area in the site.
 - 1. Layout and staking for earthwork.
 - 2. Excavation and rough grading.
 - 3. Erosion and sediment control.
 - 4. Foundation excavation for footings.
 - 5. Establishing subgrades, leveling and proofrolling.
 - 6. Filling, backfilling and compaction.
 - 7. Keeping streets clean of materials tracked off site.
 - 8. Includes trenching, excavation and backfill for utilities.
 - 9. Maintenance and/or repair of damage to the rough grading.
 - 10. Removal and disposal of stones, debris, excess and unsuitable materials.
 - 11. Field quality control, testing, and inspection.

1.4 DEFINITIONS

- A. Rock Excavation: Natural geological formations or other material which cannot be removed by adequate equipment (in good condition) as defined below shall be considered a change in the scope of work and paid for by the Owner if encountered.
 - 1. Open Excavation and Grading: Rock in excess of the capabilities of a Caterpillar D-8 tractor (or equivalent) with 2 cu. yd. bucket and hydraulically operated single tooth power ripper.
 - 2. Trenches, Pits and Footings: Rock in excess of the capabilities of a Caterpillar 235 Hydraulic Backhoe (or equivalent) using a 2 ft. Bucket width (3/4 cu. yd.)
 - 3. Minimum Effort: If rock is not removed during the process of normal digging and ripping, then extend the excavation to expose the rock surface within the limit of original excavation. Contact the Owner and he may direct the sides of rock to be exposed to a depth of 3 feet. This will be to determine to the extent of additional work.

- B. Earth Excavation: Anything not classified as rock including as example: soils, gravels, stones, boulders, vegetation, debris, and unsuitable materials.
- C. Unsuitable Materials: All excavated materials; debris, man made or fabricated materials, concrete spoil, organic, soft, expansive, or unstable matter; all shall be disposed of as herein specified. Excessive moisture content shall not classify a material as unsuitable.
- D. Removal and disposal of unsuitable material above the subgrade elevation and placement of approved specific fill material (from on or off the site) above the subgrade elevation as directed by the Soils Engineer shall be considered a part of the work.
- E. Removal and disposal of unsuitable material approved below the subgrade elevation and placement of approved specific fill material (from on or off the site) below the subgrade elevation as directed by the Soils Engineer shall be a part of the work.
- F. Soils Engineer or Inspection Agency or Owner: An Agency and its designated representatives who monitor and approve all earthwork operations described herein.
- G. Subgrade: The finished elevation of the earth immediately below all slabs, granular and porous fill, paving, footings, walls, etc., except the subgrade elevation shall not be higher than 12" below the existing earth elevation at the start of the project.
- H. Subgrade for utility construction: Underside of barrel of pipe, or underside of any cradle or bedding if noted on drawings, or referenced in applicable local government specifications. For pipe drains and miscellaneous structures encased in concrete or on concrete, stone and/or gravel cradle, subgrade is lowest outside surface of encasement or cradle.
- I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- J. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.
- K. Drainage Course: Course supporting the slab on grade that also minimizes upward capillary flow of pore water.
- L. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- M. Utilities: On site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.
- N. Filter Material: Course placed around drainage pipes.

1.5 QUALITY ASSURANCE

- A. Reference Standards:
 - 1. American Association of State Highway and Transportation Officials (AASHTO).
 - 2. American Society for Testing and Materials (ASTM).

3. Delaware Department of Transportation, State Highway Administration “Standard Specifications for Materials and Construction”, October 1993, as amended to date (M.S.H.A. as hereinafter referred). Delete references to Measurement and Payment.
- B. Geotechnical Testing Agency Qualifications: An independent testing agency (with a Geotechnical engineer licensed in the state where the project is being constructed on staff) qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548.
 - C. Tolerances: As indicated herein.
 - D. Testing: Requirements as specified herein.

1.6 SUBMITTALS

- A. Notification:
 1. Notify and provide data to regulatory authorities and Owner prior to commencement of work.
 2. Provide notice of: encounter with unknown utilities; subgrades before filling; areas requiring testing or inspection.
- B. Product Data: For the following:
 1. Geotextile.
 2. Detection Warning Tape.
- C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
 1. Classification according to ASTM D2487 of each on site and borrow soil material proposed for fill and backfill.
 2. Laboratory compaction curve according to ASTM D1557 for each on site and borrow soil material proposed for fill and backfill.
 3. Field reports; in-place soil density tests.
 4. One optimum moisture – maximum density curve for each type of soil encountered.
 5. Report of actual unconfined compressive strength and/or results of bearing tests of each strata tested.
 6. Test reports must be submitted daily to the Owner.

1.7 PROJECT CONDITIONS

- A. Subsurface Conditions: Subsurface soils investigations have been made at the site. The report and logs of the test borings and test pits are included in the Appendix of these specifications. Such investigations have been made for the purposes of design only and neither the Engineers, the Owner, nor the Geotechnical Engineer guarantee adequacy or accuracy of the data, or that data are representative of all conditions to be encountered. Such information is made available for general information only and shall not relieve the Contractor of the responsibility for making his own investigations, tests, and analysis. Any additional test borings and other exploratory operations may be made by Contractor shall be at no cost to Owner.

1. See Geotechnical Engineering Report prepared by Duffield Associates in Appendix A for test boring data and other requirements.
 2. The project site will be made available, upon request to the Owner, to allow prospective bidders and the identified contractor access to the site to confirm existing conditions and to perform additional site investigations.
- B. Erosion and sediment control, in addition to erosion control specified in Section 31100 and Division 1:
1. Standards: Comply with the requirements of the “State of Delaware Sediment and Stormwater Regulations”.
 2. Standards: Comply with the requirements of the “State of Delaware Erosion and Sediment Control Law”.
 3. Standards: Comply with the requirements of the "Standards and Specifications for Soil Erosion and Sediment Control in Developing Areas" by the U.S.D.A. Soil Conservation Service.
 4. General Erosion: Prevent erosion of earthwork; repair and correct any ditches, gullies or erosion immediately and upon occurrence.
 5. Excavations: Prevent water from flowing into open excavations and toward building walls.
 6. Slopes: Cover (with continuous plastic membrane) and stake all slopes steeper than 1.5 horizontal to 1 vertical.
- C. Existing Conditions: Accept the site in the condition which it exists at the time of the award of the contract and perform all work to the grades indicated.
1. Protect plant material, lawns and other features not designated for removal.
 2. Protect bench marks, existing structures, fences, sidewalks, paving and curbs from excavating equipment and vehicular traffic.
- D. Existing Utilities: Locate existing underground and aerial utilities in areas of work. If utilities are to remain in place, provide adequate means of protection during earthwork operations.
1. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility Owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility Owner.
 2. Do not interrupt existing utilities serving facilities occupied and used by others, except when permitted in writing by Owner and then only after acceptable temporary utility services have been provided. Provide a minimum of 48 hour notices to utility Owners and receive written notice to proceed before interrupting any utility.
- E. Rock Excavation: Rock excavation may be performed with hoe rams, jack hammers, or any method the Contractor wishes to employ except for explosives.
- 1.8 PROTECTION
- A. Safety: Provide protective measures necessary for the safety of workmen, to the public and adjacent property. Prevent cave-ins, collapse of walls, structures and slopes, both on and adjacent to the site.

- B. Standards: Comply with regulations of local authorities having jurisdiction, including all applicable O.S.H.A. requirements.
- C. Repair: Includes the removal and replacement with new materials all materials so affected by settlement.

PART 2 - PRODUCTS

2.1 FILL AND BACKFILL

A. Satisfactory Soils:

1. Compacted fill and backfill shall be free of deleterious matter such as frozen materials, organics, wood, debris, or rock larger than 4 inches in diameter and be classified SP, SW, SM, SC, GP, GC, GM, or GW per ASTM D-2487. All material shall have a liquid limit and plasticity index not exceeding 40 and 20 respectively when tested in accordance with ASTM D-4318.
2. The minimum dry unit weight shall not be less than 105 PCF maximum dry density as determined by ASTM D-1557, modified proctor.
3. All fill and backfill materials shall be obtained from on site or from off site sources and shall be approved by the Owner prior to placement.
4. Provide offsite soil materials when sufficient satisfactory soil materials are not available from proposed excavations.

- B. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with a least 90 percent passing a 1 ½ inch sieve and not more than 12 percent passing a No. 200 sieve.

1. Locations: All on site fill areas

- C. Structural Fill: On-site soils free of organic material, topsoil, miscellaneous fill, debris and rock fragments in excess of 3 inches in their largest dimension may be suitable as structural fill. The granular on-site soils may be suitable for re-use as structural fill. Some of these soils have an in-situ moisture content that exceeds the typical range that would allow the recommended compaction to be achieved. Therefore, drying of these soils may be required to achieve the recommended compaction.

If sufficient quantities of suitable on-site soils are not available for structural fill, imported borrow consisting of predominately granular soils conforming to the requirements of the Delaware Department of Transportation Standard Specifications Select Borrow, Type G should be utilized or AASHTO SP-57 stone.

D. Drainage fill:

1. Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel, (ASTM D 448 Coarse - aggregate grading size 57), with 100% passing of 1-1/2" sieve and not more than 5% passing a No. 8 sieve. Aggregate shall meet DELDOT specification for No. 106A aggregate. Provide by Contractor from off site source.

- a. Locations: All concrete slab on grade areas

2. For foundation drainage, use aggregate meeting DELDOT specification for No. 113 aggregate.
 - a. Locations: Drainage fill behind basement walls and retaining walls.
 - E. Stone Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, reclaimed concrete, and natural or crushed sand (ASTM D2490) with at least 95% passing a 1 ½” sieve and not more than 8% passing a No. 200 sieve. Provide by contractor from off site sources.
 - F. Subbase Material: Designation CR-6 in accordance with DELDOT Specifications.
 1. Locations: All vehicular traffic areas
 - G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; except with 100 percent passing a 1 inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve. For utility installations, bedding shall conform to AASHTO #57 stone.
 - H. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; AASHTO M-43, size No. 17.
 - I. Sand: ASTM C 33; fine aggregate, natural, or manufactured sand.
 - J. Processed Rubble Fill: Existing brick and concrete rubble, free of wood and steel may be processed by use of tracked equipment such that no particle size greater than 6 inches in the longest dimension remains.
 - K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.
- 2.2 FILL AND BACKFILL FOR UTILITIES
- A. Backfill: Earth removed from the trench provided that in the opinion of Owner such excavated material is satisfactory for backfilling.
 - B. Should the excavated material be considered unsatisfactory for backfilling, the Contractor shall remove and dispose of such unsatisfactory material and substitute, in lieu thereof, suitable material obtained from elsewhere on or off the site.
 - C. Materials shall meet the requirements specified in paragraph 2.1.A above.
- 2.3 TOPSOIL
- A. Refer to Section 329200 Turf and Grasses.
- 2.4 ACCESSORIES
- A. Detectable Warning Tape: Acid and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:

1. Red: Electric
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems
5. Green: Sewer systems.

2.5 GEOTEXTILES

- A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Grab Tensile Strength: 157 lbf; ASTM D 4632.
3. Sewn Seam Strength: 142 lbf; ASTM D 4632.
4. Tear Strength: 56 lbf; ASTM D 4533.
5. Puncture Strength: 56 lbf; ASTM D 4833.
6. Apparent Opening Size: No. 70 sieve, maximum; ASTM D 4751.
7. Permittivity: 0.5 per second, minimum; ASTM D 4491.
8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

- B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Grab Tensile Strength: 247 lbf; ASTM D 4632.
3. Sewn Seam Strength: 222 lbf; ASTM D 4632.
4. Tear Strength: 90 lbf; ASTM D 4533.
5. Puncture Strength: 90 lbf; ASTM D 4833.
6. Apparent Opening Size: No. 40 sieve, maximum; ASTM D 4751.
7. Permittivity: 0.02 per second, minimum; ASTM D 4491.
8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.6 FLOWABLE FILL

- A. Stabilized flowable fly ash mixture with a maximum slump of 8" and a minimum unconfined compressive strength of 100 psi used to fill construction excavations.
- B. Manufacturer: American Stone Mix or approved equal.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify existing ground surfaces have been stripped of topsoil, root mat and existing pavement, unsatisfactory soils, concrete spoil, obstructions and deleterious material.

- B. Following rough grading and prior to foundation excavation, placement of fill, placement of road base or construction of the floor slabs, it is recommended that the exposed subgrade be proofrolled. The proofroll should be performed using a fully loaded 10-ton 10-wheel dump truck in the presence of the qualified soils technician working under the supervision of a geotechnical engineer. Yielding or otherwise unsuitable subgrade conditions encountered within the proposed building areas should be undercut to firm subgrade conditions and backfilled with compacted structural fill.
- C. Locate underground utilities in areas of work. If utilities are to remain in place, provide adequate means of protection during earthwork operations. Contact "Miss Utility".
- D. Use of explosives will not be permitted, unless approved by Owner in writing and Regulatory Agencies having jurisdiction.
- E. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.
- F. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- G. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.
- H. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.2 EXCAVATION

- A. Excavation consists of removal and disposal of material encountered when establishing required finish grade elevations.
- B. Unauthorized Excavations:
 - 1. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Owner. Unauthorized excavation, as well as remedial work directed by Owner, shall be at Contractor's expense.
 - 2. Under footings, foundations, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing to excavation bottom, without altering required top elevation. Lean concrete, flo-ash fill, or compacted structural fill may be used to bring elevations to proper position, when acceptable by Owner.
- C. Additional Excavation: When excavation has reached required subgrade elevations, notify Soils Engineer who will make an inspection of conditions.
 - 1. If unsuitable bearing materials are encountered at required subgrade elevations, carry excavations deeper and replace excavated materials as directed by Owner
 - 2. Removal of unsuitable material below the subgrade elevation and its replacement as directed will be paid by the Owner on basis of contract conditions relative to change in work.

- D. Stability of Excavations: Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of materials excavated.
1. Maintain sides and slopes of excavations in safe conditions until completion of backfilling.
- E. Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers, and cross braces, in good serviceable condition.
1. Establish requirements for trench shoring and bracing to comply with local, State & Federal codes and authorities having jurisdiction.
 2. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses.
- F. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.
1. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Excavations shall be kept free of water for a minimum of two (2) inches below subgrade of excavation. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.
 2. Convey water removed from excavations and rain water into approved sediment control devices. Establish and maintain temporary drainage ditches and other diversions outside excavation limits for each structure. Do not use trench excavations as temporary drainage ditches.
 3. Excessive groundwater conditions: Refer to Article 4.3.6 of the General Conditions.
- G. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade and shape stockpiles for proper drainage.
1. Prevent saturation of soil above the optimum moisture content.
 2. Locate and retain soil materials away from edge of excavations.
 3. Dispose of excess soil material and waste materials as herein specified.
- H. Excavation for Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10', and extending sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.
1. In excavating for footings and foundations, take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive other work.
 2. If in excavating for building foundations the soil directly below the building foundations is disturbed, the disturbed soil shall be removed and shall be recompacted to 95% compaction or replaced with concrete backfill.
- I. Excavation for Trails: Cut surface under proposed trail to comply with cross sections, elevations and grades as shown:

1. Where rock or concrete spoil is encountered, carry excavation 18" below subgrade and backfill with suitable material approved by the Owner.
- J. Excavation for Trenches: Dig trenches to the uniform width required for particular item to be installed with ample working room.
1. Excavate trenches to depth, lines, gradients, and elevations indicated or required. Carry depth of trenches for piping to establish indicated flow lines and invert elevations. Beyond building perimeter, keep bottoms of trenches sufficiently below finish grade to avoid freeze ups.
 2. Where rock is encountered, carry excavation 6" below required elevation and backfill with a 6" layer of crushed stone or gravel prior to installation of pipe.
 3. Grade bottoms of trenches as indicated, notching under pipe bells to provide solid bearing for entire body of pipe.
 - a. For pipes and conduit less than 6 inches in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
 - b. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
 4. Backfill trenches with concrete where trench excavations pass within 18" of column or wall footings and which are carried below bottom of such footings, or which pass under wall footings. Place concrete to level of bottom of adjacent footing. Concrete is specified in Division 3.
 5. Do not backfill trenches until tests and inspections have been made and backfilling authorized by Owner. Use care in backfilling to avoid damage or displacement of pipe systems.
- K. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F. (1 degree C.).
- L. Ground Surface Preparation (Structural and Pavement areas):
1. The existing ground surface in the structural and pavement areas shall be stripped of topsoil, root mat, existing pavements, unsatisfactory soils, concrete spoil, obstructions and deleterious material. Base course material from the existing pavements may remain if approved by the Owner. The entire area shall be proof rolled, a minimum of four (4) passes, with a loaded dump truck with a minimum axle load of 10 tons in the presence of the soils engineer. Soft spots identified by the Soils Engineer during proofrolling will be undercut and backfilled in accordance with Section 3.4. Proofrolling and compaction equipment shall meet the requirements of Section 3.3.D. Undercutting and backfilling operations for eliminating soft spots above the subgrade elevation shall be included in the base bid.
 2. In cut areas, prior to the construction of paving or concrete slab on grade, the entire subgrade shall be proofrolled in the presence of the Soils Engineer. Soft areas encountered during proofrolling shall be undercut and backfilled in accordance with section 3.4. Proofrolling and compaction equipment shall be in compliance with Section 3.3 D. The cost of undercutting and backfilling above the subgrade elevation shall be included in the base bid.

M. Earthwork Quantities:

1. Contractor shall be responsible for determining earthwork quantities for the completion of the work.

3.3 COMPACTION

- A. General: Control soil compaction during construction providing percentage of dry density specified for each area classification.

- B. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of the maximum dry density which is determined in accordance with ASTM D 1557, or in accordance with ASTM D 2049 for soils which will not exhibit a well defined moisture density relationship.

1. Structural, pavement and walkway areas, steps and utility trenches - 95% of the maximum dry density.
2. Lawn areas outside the designated structural fill limits – minimum compaction 83% of the maximum dry density and maximum compaction of 88% of the maximum dry density.

- C. Moisture Control: Obtaining a uniformly high degree of compaction requires control over the moisture content of the material being placed in the fills and backfill. The soils used in fill and backfill shall be brought to within 3% of optimum moisture at no additional cost to the Owner.

1. Where the soil layer is too dry, the Contractor shall apply water uniformly using approved equipment to increase the moisture content to within 3% of the optimum, taking precautions to prevent free water from appearing on the surface during or subsequent to compaction operations.
2. Where the soil layer is too wet, the Contractor shall dry the soils by plowing or discing to aerate the soil and reduce the moisture content to within 3% of the optimum.

- D. Compaction equipment shall be as required to complete the scope of work outlined in the geotechnical report, contract documents and specifications for this project.

- E. **Compaction for trail construction** shall include at least two passes with a dual drum vibratory compactor to level and compact subgrade. Additional passes shall be completed until the compactor, in non-vibratory mode, does not deflect or pump the subgrade. If pumping or deflection is apparent, Contractor to completed additional measures to achieve stable subgrade.

3.4 BACKFILL AND FILL

- A. General: Place acceptable soil material in layers not more than eight (8) inches in thickness to required subgrade elevations, for each area classification listed below. Each layer shall be compacted to the requirements of Section 3.3B.

1. Fill and backfill within building and pavement limits and in utility trenches shall be structural fill soils meeting the requirements of Section 2.1.A.
2. Under lawn areas outside the designated structural fill limits, backfill and fill soils shall be soils meeting the requirements of Section 2.1.A, or other on site materials approved by the Geotechnical Engineer.

3. Fill and backfill located below walkways and steps shall be constructed of structural fill soils meeting the requirements of Section 2.1.A.
 4. Drainage fill material shall be proof rolled to a uniform stable condition prior to placement of vapor retarder.
 5. Stone base course shall be compacted to 95% maximum dry density per ASTM D-1557.
- B. Backfill excavations as promptly as work permits, but not until completion of the following:
1. Acceptance of construction below finish grade including, where applicable, subdrainage damp proofing, waterproofing, and perimeter insulation.
 2. Concrete and masonry have cured 28 days and is adequately braced.
 3. Inspection, testing, approval, and recording locations of underground utilities.
 4. Removal of concrete formwork.
 5. Removal of trash and debris.
 6. Removing temporary shoring and bracing, and sheeting.
 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- C. Ground surface preparation: Shall be in accordance with Section 2.3.L.
1. When existing ground surface has density less than that specified under Section 3.3B for particular area classification, break up ground surface, pulverize, moisture condition to optimum moisture content, and compact to required depth and percentage of maximum dry density.
- D. Placement and Compaction: Place backfill and fill materials in layers not more than 8" in loose depth, for material compacted by heavy compaction equipment and not more than 4" in loose depth for material compacted by hand operated tampers.
1. Before compaction, moisten or aerate each layer as may be necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density for each classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
 2. Place backfill and fill materials evenly adjacent to structures, to required elevations. Take care to prevent wedging action of backfill against structures by carrying material uniformly around structure to approximately same elevation in each lift.
 3. Structural fill shall extend a minimum of five (5) feet beyond building and road pavement limits and shall include the support slopes to their full width.
 4. Backfilling against pipe structures, whose joints involve the use of cement mortar or other concrete, or where buttresses are constructed, shall not be done until mortar has set at least 12 hours.
 5. Compaction over one foot above the pipe shall be done with approved mechanical tampers. Compaction density shall be as specified in Section 3.3.
- E. Utility trench backfill
1. Place and compact initial backfill of subbase material, free of particles larger than 1 inch, to a height of 12 inches over the utility pipe or conduit. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.
 2. Coordinate backfilling with utilities testing.
 3. Provide 4-inch thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or

conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase.

4. Fill voids with approved backfill materials while shoring, bracing, and sheeting is removed.
5. Place and compact final backfill of satisfactory soil material to final subgrade.
6. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.5 ROUGH GRADING

- A. General: Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surfaces with specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades. In fill areas, sloped surfaces steeper than 5 horizontal to 1 vertical shall be benched so that fill materials will be placed on a level surface. All fill subgrades shall be observed by the Geotechnical Engineer.
- B. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish surfaces free from irregular surface changes, and as follows:
 1. Lawn or Unpaved Areas: Finish areas to receive topsoil to within not more than 0.10' above or below required subgrade elevations.
 2. Walks: Shape surface or areas under walks to line, grade and cross section, with finish surface not more than .04' above or below required subgrade elevation.
 3. Pavements: Shape surface areas under pavement to line, grade and cross section, with finish surface not more than .04' for bituminous surfaces and .08' for stone surfaces, above or below required subgrade elevation.
- C. Grading Surface or Fill Under Building Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of .02' when tested with a 10' straightedge.

3.6 BUILDING SLAB BASE COURSE

- A. General: Slab base course consists of placement of drainage fill or stone base course material, in layers of indicated thickness, over subgrade surface to support concrete building slabs.
- B. Placing: Place slab base course on prepared subgrade in layers of uniform thickness, conforming to indicate cross section and thickness. Maintain optimum moisture content for compacting material during placement operations.
 1. When a compacted drainage course is shown to be 6" thick or less, place material in a single layer. Where shown to be more than 6" thick, place material in equal layers, except no single layers more than 6" or less than 3" in thickness when compacted.
- C. Any ruts or soft yielding spots which may occur or any areas having inadequate compaction or deviations from the requirements set forth herein shall be corrected by removing and adding uniformly graded crushed stone or by loosening crushed gravel, reshaping and recompacting. The subgrade shall have a uniform density throughout its entire depth and width and shall be approved by the Owner prior to pouring any concrete.

D. Following this preparation, the subgrade shall be protected from damage as described below:

1. The subgrade shall be protected from damage by heavy loads or equipment moving on tracks or cleats.
2. The contractor shall at all times keep the subgrade drained.
3. No concrete shall be deposited upon a frozen subgrade nor, until the subgrade has been approved by the Owner.
4. Immediately in advance of placing concrete, the subgrade shall be sprinklered with as much water as it can readily absorb.

3.7 FINISH GRADING & PLACING TOPSOIL

A. Refer to Specification Section 329200 – “Turf and Grasses”

3.8 MAINTENANCE

- A. Protection of graded areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris. Repair and re establish grades in settled, eroded and rutted areas to specified tolerances.
- B. Reconditioning compacted areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.
- C. Restore areas previously occupied by stockpiled materials to match finished condition of the remainder of the work.

3.9 DISPOSAL OF EXCESS AND WASTE MATERIALS

A. Removal from Owner's Property: Remove waste materials including trash, debris, and unsuitable and excess excavated material, and dispose of off Owner's property.

3.10 FIELD QUALITY CONTROL – SOILS

- A. Quality Control Testing During Construction: Allow testing service to inspect and approve subgrades and fill layers before further construction work is performed.
1. Perform field density tests in accordance with ASTM D 1556 (sand cone method) or ASTM D 2922 and D-3017(shallow depth nuclear method), as applicable.
 2. Paved Areas and Building Slab Subgrade: Make at least one field density test of subgrade for every 2,000 sq. ft. of paved area or building slab area, but in no case less than 3 tests. In each compacted fill layer, make one field density test for every 2,000 sq. ft. of overlaying building slab or paved area, but in no case less than 2 tests. Field density tests shall be made at all walkway entrances and ramps into the proposed building.
 3. Foundation Wall Backfill: Take enough field density tests to ensure backfill is being properly compacted.
 4. Utility Trench Backfill: Perform field density tests on a spot-check basis to assist the Contractor in determining if compaction is in accordance with the specifications.
 5. If in opinion of Owner, based on testing service reports and inspection, subgrade or fills which have been placed are below specified density, provide additional compaction and testing at no additional expense.

6. Footing Subgrade: For each strata of soil on which footings will be placed, conduct at least one test to verify required design bearing capacities. Subsequent evaluation and approval of each footing subgrade should be performed by Geotechnical Testing Agency.
7. Costs of testing and inspection shall be borne by the Contractor.

3.11 TESTING AND INSPECTION

- A. INSPECTION AGENCY: Owner will employ an Independent Testing agency for purposes of inspecting and testing construction of embankments, fills, backfills, trenches, and subgrades.
- B. Scheduling:
 1. Assign qualified personnel to be on site at all times when operations are scheduled.
 2. The Contractor should note that no earthwork operation shall be permitted in their absence.
- C. Responsibilities:
 1. Evaluation of subgrade preparation and suitability.
 2. Moisture content and field density tests on all layers of fill and backfill material placed.
 3. Evaluation of degree of compaction attained for all fill and backfill material placed.
 4. Testing and evaluation of borrow material.
 5. Sources of borrow and of select fill.
 6. Footing subgrade suitability.
 7. Inspection of installation of Subdrainage system.
- D. Final Report: The Inspection Agency shall prepare a written report that summarizes the work inspected during the course of the project. A discussion of all deviations from the contract documents and specifications, with their related impact on the final construction, shall be described in detail. The engineer of record shall review this final report, and recommend corrective measures (as deemed necessary) that must be made prior to final acceptance of the work. Prior to final payment, a written report certifying that the work meets the requirements of the contract documents, specifications, and all governing agencies shall be prepared, submitted, and approved by the Owner.

END OF SECTION 312000

SECTION 312319 - DEWATERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes construction dewatering.
- B. Related Sections include the following:
 - 1. Division 01 Section "Temporary Construction Utilities, Facilities and Controls" for temporary utilities and support facilities.
 - 2. Division 31 Section "Earth Moving" for excavating, backfilling, site grading and for site utilities.
 - 3. Division 31 Section "Excavation Support and Protection."

1.3 PERFORMANCE REQUIREMENTS

- A. Dewatering Performance: furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control ground-water flow into excavations and permit construction to proceed on dry, stable subgrades.
 - 1. Maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, that excavation does not flood, and that damage to subgrades and permanent structures is prevented.
 - 2. Prevent surface water from entering excavations by grading, dikes, well pointing or other means.
 - 3. Accomplish dewatering without damaging existing buildings adjacent to excavation.
 - 4. Remove dewatering system if no longer needed.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with water disposal requirements of authorities having jurisdiction.
 - 1. Jurisdictions include:
 - a. Town of Ocean View
 - b. Sussex County, Delaware
 - c. Delaware Department of Natural Resources and Environmental Control
 - d. And, any other applicable regulatory body.
- B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.5 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner, or others unless permitted in writing by the Owner, Municipality and utility provider and then only after arranging to provide temporary utility services according to requirements indicated.
- 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 this data.
 - 1. Make additional test borings and conduct other exploratory operations necessary for dewatering.
 - 2. The geotechnical report is appended to the contract documents at Appendix A.
- C. Survey adjacent structures and improvements, employing a qualified professional engineer or land surveyor, establishing exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.
 - 1. During dewatering, regularly resurvey benchmarks , maintaining an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Owner and municipality if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.
 - 1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site and surrounding area.
 - 2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
- B. Install dewatering system 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.

3.2 INSTALLATION

- A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.
- B. Before excavating below ground-water level, place system into operation to lower water to specified levels. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed, or until dewatering is no longer required.
- C. Provide an adequate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.
 - 1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
- D. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
 - 1. Maintain piezometric water level below surface of excavation.
- E. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water in a manner that avoids inconvenience to others. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.
- F. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures and foundation soils at no additional expense to Owner.
 - 1. Remove dewatering system from Project site on completion of dewatering.
- G. Damages: Promptly repair damages to adjacent facilities caused by dewatering operations.

3.3 OBSERVATION WELLS

- A. Provide, take measurements, and maintain at least the minimum number of observation wells or piezometers indicated and additional observation wells as may be required by authorities having jurisdiction.
- B. Observe and record daily elevation of ground water and piezometric water levels in observation wells.
- C. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. Suspend construction activities in areas where observation wells are not functioning properly until reliable observations can be made. Add or remove water from observation-well risers to demonstrate that observation wells are functioning properly.

1. Abandon observation and dewatering wells in accordance with *Delaware Regulations Governing the Construction and Use of Wells* and in coordination with DNRECs, remove piezometers, restore the site per contract requirements.

END OF SECTION 312319

SECTION 329200 - TURFS AND GRASSES

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Meadow Area Seeding.
 - 2. Hydroseeding.
 - 3. Erosion-control material(s).

1.2 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful turf establishment.
 - 1. Experience: Five years experience in turf installation in addition to requirements in Division 01 Section "Quality Requirements."
 - 2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 - 3. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
 - 4. Pesticide Applicator: State licensed, commercial.
- B. Soil-Testing Laboratory Qualifications: An independent laboratory or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
- C. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of the soil.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable.

1.4 PROJECT CONDITIONS

- A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of substantial completion.
 - 1. Warm Season Grasses
 - a. Spring: April 15th – June 15th.
 - b. Fall: August 15th – September 15th.

1.5 MAINTENANCE SERVICE

A. Warm Season Grass Meadows: Maintain low and high meadow areas, for a minimum of 90-days, including watering, (unless natural rainfall provides at least ½” of water per week), spot weeding, mowing, applications of herbicides, insecticides and re-seeding until a full uniform stand of meadow grass, free of weeds, undesirable grass species, disease and insects is achieved and accepted. Provide initial mowings in both the fall, after October 30th and prior to April 1st, mowing meadow areas to a height of 6” for the first year after acceptance by the Owner.

PART 2 - PRODUCTS

2.1 MEADOW SEED

A. Seed Species: State-certified seed of grass species as follows:

1. Meadow areas:

Warm season grass mix

ERNMX - 117

Distributed by : Ernst Conservation Seeds, 9006 Mercer Pike, Meadville, PA, 16335

Phone 1-800-873-3321 (or approved equal).

- 70% Oats, Armor, Certified (*Avena sativa*, Armor, Certified)
- 10% Indian Grass, PA Ecotype (*Sorghastrum nutans*, PA Ecotype)
- 10% Little Blue Stem 'Camper' (*Schizachyrium scoparium* 'Camper')
- 5% Swtichgrass 'Cave-In-Rock' (*Panicum virgatum*. 'Cave-In-Rock')
- 5% Big Blue Stem 'Southlow' MI Ecotype (*Andropogon gerardii* 'Southlow' - MI Ecotype)

B. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:

1. Class: O, with a minimum of 95 percent passing through No. 8 sieve and a minimum of 55 percent passing through No. 60 sieve.
2. Provide lime in form of ground dolomitic limestone or calcitic limestone.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Aluminum Sulfate: Commercial grade, unadulterated.

E. Perlite: Horticultural perlite, soil amendment grade.

F. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve.

G. Sand: Clean, washed, natural or manufactured, and free of toxic materials.

H. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.

I. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.2 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content of 5 or less decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings.

- B. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

2.3 PLANTING SOILS

- A. Planting Soil: Imported topsoil or manufactured topsoil from on site sources. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep; do not obtain from agricultural land, bogs, or marshes.
- B. Straw Mulch: Provide air dried, clean, mildew and seed free salt hay or threshed straw of wheat, rye, barley or oats.
- C. Preparation of Soil
 1. Prepare sub-soil to eliminate uneven areas and low spots. Maintain lines, levels, profiles and contours. Make changes in grade gradual. Blend slopes into level areas.
 2. Remove foreign materials, weeds and undesirable plants and their roots. Remove contaminated sub-soil.
 3. Scarify subsoil to a depth of 5 inches where topsoil is to be placed. Repeat cultivation in area where equipment, used for hauling and spreading topsoil, has compacted sub-soil.
- D. Placing Topsoil
 1. Spread topsoil to a minimum depth of 6 inches over areas to be seeded. Rake until smooth.
 2. Place topsoil during dry weather and on dry unfrozen subgrade.
 3. Remove vegetable matter and foreign non-organic material from topsoil while spreading, remove stones over 1" in diameter.
 4. Grade topsoil to eliminate rough, low soft areas, and to ensure proper drainage according to grading plan.

2.4 PESTICIDES

- A. General: Pesticide, registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

2.5 EROSION-CONTROL MATERIALS

- A. Erosion-Control Blankets: Provide erosion control blankets on slopes steeper than 4:1 and also in the swales. Biodegradable wood excelsior, straw, or coconut-fiber net less, erosion control blanket. Blanket shall be anchored with bio-degradable "Futura" stakes erosion control blanket and stakes shall be mfg. by Futura (www.futura.com) or approved equal.

PART 3 - EXECUTION

3.1 INSPECTIONS

- A. Examine finish surfaces, grades, topsoil quality and depth. Do not start seeding work until unsatisfactory conditions are corrected.

3.2 PREPARATION: Warm Season Grasses

- A. Limit preparation to areas which will be immediately seeded.
- B. Remove existing temporary lawn and other vegetation and dispose of such material outside of Owner's property. Do not turn existing vegetation over into soil being prepared for permanent lawn. Option Method: use "round-Up" spray a minimum of two weeks prior to preparation to avoid removal of vegetation and topsoil loss. Incorporate organic residue into top 6" as before.
- C. Warm Season Grasses: preparation – apply Round-Up® herbicide according to manufactures direction to area to be planted with grasses and wildflowers. Allow vegetation to die and remove dead vegetation debris. Fine grade to remove stones larger than 1" in diameter, debris, mounds or depressions. Bring soil to an even finished grade. Irrigate to encourage germination of any additional weed seeds. Re-apply Round-Up herbicide in accordance with manufacturers direction. Rake out dead vegetative debris. Allow soil to recover for 3-weeks prior to seeding with Meadow Grasses.
- D. Loosen topsoil of lawn area to a minimum depth of 6" Remove stones over 1" in dimension and sticks, roots, rubbish and extraneous matter.
- E. Grade lawn and meadow areas to a smooth, free draining even surface with a loose, moderate course texture. Roll, rake and remove ridges and fill depressions as required to drain.
- F. Apply limestone at the rate determined by soils test to adjust pH of topsoil to not less than 6.0 or more than 6.8.
- G. Apply fertilizer at a rate determined by soils test (lawn areas only).
- H. Restore prepared areas to specified condition if eroded settled or otherwise disturbed after fine grading and prior to seeding.

3.3 INSTALLATION

B. Warm Season Grass Seeding:

1. Seed immediately after the preparation of bed. Spring seeding April 15th and June 1st and fall seeding between August 1st and September 15th or at such other times acceptable to the Landscape Architect.
2. Seed indicated areas within contract limits and areas adjoining contract limits disturbed as a result of construction operations.
3. Perform seeding operations when the soil is dry and when winds do not exceed 5 miles per hour.
4. Apply seed with approved billion drill seeder.
5. Sow seed at a rate of:
Warm season grasses: 40 pounds per acre.
6. Tracking & rolling : after sowing seed, rake or track the area lightly to firm the soil and provide seed –soil contact. The finished grade of the seeded area must present an even, smooth and finished appearance.

C. Mulching:

1. Straw mulch: straw shall be spread over all seeded areas at the rate of 2/50 tons per acre. Mulch shall be applied to a uniform loose depth of not less than 1" no more no more than 2". Mulch applied shall achieve a uniform distribution and depth so that no more than 10% of soil surface is exposed. Secure with a mulch anchoring tool. Punch, crimp and anchor mulch into the soil surface a minimum of 2".

D. Acceptance:

2. Seeded areas will be inspected at completion of installation and accepted subject to compliance with specified materials and installation requirements.
3. Seeded areas will be acceptable provided all requirements, including maintenance have been complied with, a healthy, , even-colored, viable lawn is established, free of weeds, undesirable grass species, disease and insects.
4. No individual lawn or meadow areas shall be bare spots or unacceptable cover totaling more than 10 % of the individual area in areas requested to be inspected.
5. Upon acceptance the Owner shall assume lawn and meadow maintenance.

E. Cleaning:

6. Perform cleaning during installation of the work and upon completion of work. Remove from the site all excess materials, debris and equipment. Repair damage resulting from seeding, and lawn renovation operations.

F. Clean Up & Inspection:

7. Upon completion of the work and maintenance, the grounds shall be cleared of all debris and equipment, which shall be entirely removed from the premises, to the satisfaction of the Owner and the landscape architect.
8. Final inspection shall be made at the conclusion of the maintenance period. Written notice to the Owner requesting inspection should be submitted at least 10-days prior to anticipated inspection date.

END OF SECTION 329200

SECTION 329300 - PLANTINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plants.
2. Tree Stabilization.

1.2 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful establishment of plants.

1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
2. Experience: Three years' experience in landscape installation in addition to requirements in Division 01 Section "Quality Requirements."
3. Pesticide Applicator: State licensed, commercial.

B. Soil-Testing Laboratory Qualifications: An independent or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

C. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of the soil.

D. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

E. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.

1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
2. Other Plants: Measure with stems, petioles, and foliage in their normal position.
3. Plants larger in size than specified in the Plant List may be used if approved. The use of larger plants shall not increase the contract price. If the use of larger plants is approved, the ball of earth or spread of roots shall be increased in proportion to the size of the plant. If plants required to be bare-root are furnished in sizes greater than specified, they shall be balled and burlapped. Provide plants indicated by two measurements so that only a maximum of 25% of the minimum size are used and 75% of the maximum size indicated are used.

F. Plant Material Observation: Landscape Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Architect retains right to observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Landscape Architect of sources of planting materials seven days in advance of delivery to site.

G. Preinstallation Conference: Conduct conference at Project site.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.

C. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

D. Handle planting stock by root ball.

E. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1.4 PROJECT CONDITIONS

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. Containerized and B&B Plants- Spring Planting: March 1st to May 1st.
2. Containerized and B&B plants - Fall Planting: September 15th to November 30th.
3. Bare Root Plants – Spring planting February 15th to April 1st.
4. Bare Root Plants – Fall planting: October 15th to December 15th.

1.5 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:

- a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.
- b. Structural failures including plantings falling or blowing over.
- c. Faulty performance of tree stabilization and edgings.
- d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Periods from Date of Substantial Completion:

- a. Trees and Shrubs: 12 months and replacement plants an additional 12 months.

3. Include the following remedial actions as a minimum:
 - a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
 - b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
 - c. Replace in accordance with the drawings and specifications, all plants that area dead or as determined by the Landscape Architect are in an unhealthy or unsightly condition and have lost their natural shape due to dead branches, or other causes due to the Contractor's negligence. The cost of such replacement is at the Contractors expense. Warrant all replacement plants for one year after installation.

1.6 MAINTENANCE SERVICE

- A. Initial Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.

1. Maintenance Period: 6 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule or Plant Legend shown on Drawings and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

2.2 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
 1. Class: O, with a minimum of 95 percent passing through No. 8 sieve and a minimum of 55 percent passing through No. 60 sieve.
 2. Provide lime in form of ground dolomitic limestone or calcitic limestone.
- B. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- C. Aluminum Sulfate: Commercial grade, unadulterated.
- D. Perlite: Horticultural perlite, soil amendment grade.
- E. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve.
- F. Sand: Clean, washed, natural or manufactured, and free of toxic materials.

- G. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.
- H. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.3 ORGANIC SOIL AMENDMENTS

- A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content of 5 or less decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
- B. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.4 FERTILIZERS

- A. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition: 10 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.

2.5 MULCHES

- A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
 - 1. Type: Double Shredded hardwood. Free of foreign and toxic substances. 6-months old, well rotted shredded native hardwood bark mulch, free of woodchips and sawdust.
 - 2. Size Range: 3 inches maximum, 1/2 inch minimum.
 - 3. Color: Natural.

2.6 PESTICIDES

- A. General: Pesticide registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

2.7 TREE STABILIZATION MATERIALS

- A. Stakes and Guys:
 - 1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated, pointed at one end.
 - 2. Wood Deadmen: Timbers measuring 8 inches in diameter and 48 inches long, treated with specified wood pressure-preservative treatment.
 - 3. "Tree Strap", Arbor Tape or approved equal for guying trees, weather resistant webbing, 900 lb. tensile strength, Black or Green in Color.
 - 4. Flags: Standard surveyor's plastic flagging tape, white, 6 inches long.
- B. Root-Ball Stabilization Materials:

1. Upright Stakes and Horizontal Hold-Down: Rough-sawn, sound, new hardwood or softwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated; stakes pointed at one end.
2. Wood Screws: ASME B18.6.1.

2.8 MISCELLANEOUS PRODUCTS

- A. Wood Pressure-Preservative Treatment: AWWA C2, with waterborne preservative for soil and freshwater use, acceptable to authorities having jurisdiction, and containing no arsenic; including ammoniacal copper arsenate, ammoniacal copper zinc arsenate, and chromated copper arsenate.
- B. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.
- C. Burlap: Non-synthetic, biodegradable.

PART 3 - EXECUTION

3.1 TREES & SHRUBS

- A. The Installing Contractor will provide and pay for materials testing. Testing agency shall be acceptable to the Landscape Architect. Provide the following data:
 1. Test all areas shown on plan for planting to determine soil suitability for planting. Test soil for:
 - a. pH factor
 - b. mechanical analysis
 - c. percentage of organic content.
 - d. Provide recommendations on type and quantity of additives required to establish satisfactory pH factor, percentage of organic matter and supply of nutrients to bring up to satisfactory levels for planting and which are acceptable to the Landscape architect.
 2. Planting: location for all plants and outlines for planting areas shall be staked on the ground and must be approved before any excavation is made. Adjustments in location and outlines shall be as directed. The landscape contractor is responsible for locating and protecting underground utilities in the planting areas.
 3. All pits and pockets shall be circular in outline: all excavations shall have vertical sides unless otherwise shown on the drawing. The depths. Specified for excavation of planting areas shall be the depths below finished grade and shall be increased as much as may be necessary to accommodate beneath the ball or roots, a bead of topsoil not less than 4" in depth upon which the ball or roots shall rest when planted is set properly to finished grade.
 4. All topsoil used for planting shall be thoroughly and uniformly mixed with peat or composted humus in a portion by volume of one part peat or composted humus to 2 parts topsoil. All groundcover and perennial beds shall be spread with 1" thick layer of peat or humus prior to cultivation.
 5. Excess and unsatisfactory excavated soil shall be disposed of by the Contractor. Satisfactory subsoil must be granular in texture.
 6. All plants shall be planted in pits unless otherwise specified. Deep planting shall be avoided and, unless specified or directed otherwise, all plants shall be set at such a level that, after settlement, a normal or natural relationship of the crown of the plant with the ground surface will be established, Each plant to be planted in an individual pit or pocket shall be planted in the center thereof, unless directed otherwise.

7. When balled and burlapped plants are set, the prepared topsoil shall be tamped carefully under and around the base of each ball to fill all voids. All burlap, ropes, wires, etc. shall be removed from the sides and tops of the balls but no burlap shall be pulled out from under the balls.
8. Roots of bare rooted plants shall be spread out properly and the prepared top soils shall be worked in carefully among them. Broken or frayed roots shall be cut off properly.
9. All plants shall be planted in the prepared topsoil which shall be settled thoroughly by tamping and watering. A shallow saucer shall be formed at finished grade about each plant by placing a mound of topsoil around the edge of each pit or pocket.
10. All trees shall be supported immediately after planting. All trees shall be guyed. wires shall be encased in hose wherever they came in contact with the trunk or branches, and shall be placed around the trunk in a single loop. Wires shall be tightened and kept taut with turnbuckles for guys and by twisting the strands together when staking.
11. Guying shall be done with three guys spaced equally about each tree. Each guy shall consist of two strands of wire attached to the tree trunk at about 2/5's the height of the tree, and anchored to the ground either to notched stakes which have been driven into the ground at an angle away from the tree so that the tops of the anchor stakes are below finished grade, or to deadmen, placed at least 3' below finished grade. Guys must be taut and be kept taut. Guys shall be made more visible by attaching small white wooden flags.
12. Stakes shall be equally spaced about each tree and shall be driven vertically into the ground to a depth of 2-1/2' - 3' in such a manner as to not injure the ball or roots. Trees shall be fastened to each stake at a height of about 5'. Stakes shall be uniform in height. Trees 3" in caliper and over shall have 3 stakes. Trees less than 3" in caliper shall have 2 stakes.
13. Where shrubs are arranged in a group, the areas between the pits shall be filled to finished grade with acceptable soil from the excavation of the plant pits or from other sources. After this filling has been completed, but prior to mulching, the soil between the plants shall be cultivate to a depth of 4" and raked smooth. The cultivated area shall then be marked off neatly.
14. Groundcover plantings shall be planted securely in pockets dug in the cultivated, mulched beds. Balls of potted plants shall be broken or sliced gently to provide better adhesion with the soil.
15. Pruning: all new plant materials shall be pruned at the site in accordance with standard modern practice. Pruning shall remove all dead or damaged branches, twigs and roots; the plants shall be shaped as directed or to preserve the natural character.
16. Mulching: after the work of setting plants and cultivating within groups of plants has been completed and approved, the area within the outline of each plant pit as specified and the entire area of all planting spaces within beds shall be mulched with a 3" layer of mulch of approved material.
17. Groundcover beds shall be mulched with a 2" layer of approved mulch material prior to planting.
18. In-organic mulch (Spread River Jacks to a depth of 3" over polypropylene weed barrier.

3.2 MAINTENANCE & ACCEPTANCE

A. Trees, shrubs and plantings.

1. Maintain plantings until completion and acceptance of the entire project.
2. Maintenance shall include pruning, cultivating, weeding, watering and application of appropriate insecticides and fungicides necessary to maintain plants free from insects and disease.
3. Re-set settled plants to proper grade and position. Restore planting saucer and adjacent material and remove dead material.
4. Tighten and repair guy wires and stakes as required. Correct defective work as soon as possible after deficiencies become apparent and weather and season permit.
5. Water trees, plants and groundcover beds within the first 24 hours after planting, and not less than twice per week until final acceptance. The Owner shall take over watering upon the final acceptance and will water once weekly from April 1st to December 1st when natural rainfall is less than 1" per week.
6. Warrant plant material to remain alive and be in a healthy, vigorous condition for a period of one year after completion and acceptance of the entire project.

7. Inspection of plants will be made by the Landscape Architect at the completion of planting.
8. Remove and immediately replace all plants as determined by the Landscape Architect to be unsatisfactory during the initial planting installation.
9. Remove all tree stakes and guy wires from trees and site at the end of the one year warranty period.

3.3 CLEAN – UP AND INSPECTION

- A. Clearing and clean up - Upon completion of the work, the grounds shall be cleared of all debris, of superfluous materials, and all equipment, which shall be entirely removed from the premises, to the satisfaction of the Owner.
- B. Final Inspection - final inspection of plantings shall be made at the conclusion of the maintenance period. Written notice to the Landscape Architect requesting inspection should be submitted at least 10 days prior to the anticipated date.

END OF SECTION 329300

Section 356001: Helical Piles for Structural Support

1. GENERAL

1.1 Purpose of Specification

The purpose of this specification is to detail the furnishing of all designs, materials, tools, equipment, labor and supervision, and installation techniques necessary to install Helical Piles as detailed on the drawings, including connection details.

1.2 Scope of Work

This work consists of furnishing all necessary supervision, labor, tools, materials, and equipment to perform all work necessary to install the Helical Piles, per the specifications described herein, and as shown on the drawings. The Contractor shall install a Helical Pile that will develop the load capacities as detailed on the drawings.

1.3 Qualifications of the Helical Pile Contractor

The Helical Pile Contractor shall be experienced in performing design and construction of Helical Piles and shall furnish all materials, labor, and supervision to perform the work. The Contractor shall be trained and certified by the pile manufacturer in the proper methods of design and installation of Helical Piles.

The Helical Pile Contractor shall not sublet the whole or any part of the contract without the express written permission of the Owner.

1.4 Definitions

A partial list follows.

Contractor: The person/firm responsible for performing the Helical Pile work.

Coupling: Central steel shaft connection means formed as integral part of the plain extension shaft material. For Type SS & RS Helical Piles, couplings are internal or external sleeves, or hot upset forged sockets.

Coupling Bolt(s): High strength, structural steel fasteners used to connect Helical Pile segments together. For Type SS segments, the coupling bolt transfers axial load. For Type RS segments, the coupling bolts transfer both axial and torsional forces.

Helical Extension: Helical Pile foundation component installed immediately following the lead or starter section, if required. This component consists of one or more helical plates welded to a central steel shaft of finite length. Function is to increase bearing area.

Helix Plate: Generally round steel plate formed into a ramped spiral. The helical shape provides the means to install the helical pile, plus the plate transfers load to soil in end bearing. Helix plates are available in various diameters and thickness.

Helical Pile: A bearing type foundation element consisting of a lead or starter section, helical extension (if so required by site conditions), plain extension section(s), and a pile cap. A.k.a. helical screw pile, screw pile, helical screw foundation.

Installation Torque (T): The resistance generated by a Helical Pile when installed into soil. The installation resistance is a function of the soil type, and size and shape of the various components of the Helical Pile.

Lead Section: The first Helical Pile foundation component installed into the soil, consisting of single or multiple helix plates welded to a central steel shaft. A.k.a. Starter Section.

Pile Cap: Connection means by which structural loads are transferred to the Helical Pile. The type of connection varies depending upon the requirements of the project and type of Helical Pile material used.

Round Shaft (RS): Round steel pipe central Shaft elements ranging in diameter from 2-7/8" to 10". A.k.a. Hollow Shaft (Type HS), Type T/C, Type PIF.

Plain Extension: Central steel shaft segment without helix plates. It is installed following the installation of the lead section or helical extension (if used). The segments are connected with integral couplings and bolts. Plain extensions are used to extend the helix plates beyond the specified minimum depth and into competent load bearing stratum.

Safety Factor: The ratio of the ultimate capacity to the working or design load used for the design of any structural element.

Square Shaft (SS): Solid steel, round-cornered-Square central Shaft elements ranging in size from 1-1/4" to 2-1/4". A.k.a. Type SQ.

Torque Strength Rating: The maximum torque energy that can be applied to the helical pile foundation during installation in soil, a.k.a. allowable, or safe torque.

1.5 Allowable Tolerances

- 1.5.1 Centerline of Helical Piles shall not be more than 3 inches from indicated plan location.
- 1.5.2 Helical Pile plumbness shall be within 2° of design alignment.
- 1.5.3 Top elevation of Helical Pile shall be within +1 inch to -2 inches of the design vertical elevation.

1.6 Quality Assurance

- 1.6.1 Helical Piles shall be installed by authorized certified Contractor. These Contractors shall have satisfied the certification requirements relative to the technical aspects of the product and installation procedures as therein specified. Certification documents shall be provided to the Owner or their representative.
- 1.6.2 The Contractor shall employ an adequate number of skilled workers who are experienced in the necessary crafts and who are familiar with the specified requirements and methods needed for proper performance of the work of this specification.

- 1.6.3 All Helical Piles shall be installed in the presence of a designated representative of the Owner unless said representative informs the Contractor otherwise. The designated representative shall have the right of access to any and all field installation records and test reports.
- 1.6.4 Helical Pile components as specified therein shall be manufactured by a facility whose quality systems comply with ISO (International Organization of Standards) 9001 requirements. Certificates of Registration denoting ISO Standards Number shall be presented upon request to the Owner or their representative.
- 1.6.5 Provide a standard one-year warranty on materials and workmanship of the product. Any additional warranty provided by the Contractor shall be issued as an addendum to this specification.

1.7 Ground Conditions

The Geotechnical Report, including logs of soil borings as shown on the boring location plan, is available to all bidders and shall be considered to be representative of the in-situ subsurface conditions likely to be encountered on the project site.

2 REFERENCED CODES AND STANDARDS

Standards listed by reference, including revisions by issuing authority, form a part of this specification section to the extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title, or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation. In case of conflict, the particular requirements of this specification shall prevail. The latest publication as of the issue of this specification shall govern, unless indicated otherwise.

2.1 American Society for Testing and Materials (ASTM):

- 2.1.1 ASTM A29/A29M Steel Bars, Carbon and Alloy, Hot-Wrought and Cold Finished.
- 2.1.2 ASTM A36/A36M Structural Steel.
- 2.1.3 ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
- 2.1.4 ASTM A153 Zinc Coating (Hot Dip) on Iron and Steel Hardware.
- 2.1.5 ASTM A252 Welded and Seamless Steel Pipe Piles.
- 2.1.6 ASTM A775 Electrostatic Epoxy Coating
- 2.1.7 ASTM A193/A193M Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service.
- 2.1.8 ASTM A320/A320M Alloy-Steel Bolting Materials for Low Temperature Service.
- 2.1.9 ASTM A325 Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
- 2.1.10 ASTM A500 Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- 2.1.11 ASTM A513 Standard Specification for Electric Resistance Welded Carbon and Alloy Steel Mechanical Tubing.
- 2.1.12 ASTM A536 Standard Specifications for Ductile Iron Castings
- 2.1.13 ASTM A572 HSLA Columbium-Vanadium Steels of Structural Quality.
- 2.1.14 ASTM A618 Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing.
- 2.1.15 ASTM A656 Hot-Rolled Structural Steel, High-Strength Low-Alloy Plate with Improved Formability.
- 2.1.16 ASTM A958 Standard Specification for Steel Castings, Carbon, and Alloy, with Tensile Requirements, Chemical Requirements Similar to Wrought Grades.

- 2.1.17 ASTM A1018 Steel, Sheet and Strip, Heavy Thickness Coils, Hot Rolled, Carbon, Structural, High-Strength Low-Alloy, Columbium or Vanadium, and High-Strength Low-Alloy with Improved Formability.
- 2.1.18 ASTM D1143 Method of Testing Piles Under Static Axial Compressive Load.
- 2.1.19 ASTM D3689 Method of Testing Individual Piles Under Static Axial Tensile Load.

2.2 American Welding Society (AWS):

- 2.2.1 AWS D1.1 Structural Welding Code – Steel.
- 2.2.2 AWS D1.2 Structural Welding Code – Reinforcing Steel.

2.3 American Society of Civil Engineers (ASCE):

- 2.3.1 ASCE 20-96 Standard Guidelines for the Design and Installation of Pile Foundations.

2.4 Deep Foundations Institute (DFI):

- 2.4.1 *Guide to Drafting a Specification for High Capacity Drilled and Grouted Micropiles for Structural Support*, 1st Edition, Copyright 2001 by the Deep Foundation Institute (DFI).

2.5 Society of Automotive Engineers (SAE):

- 2.5.1 SAE J429 Mechanical and Material Requirements for Externally Threaded Fasteners.

3 SUBMITTALS

3.1 Construction Submittals

- 3.1.1 The Contractor shall submit a detailed description of the construction procedures proposed for use to the Owner for review. This shall include a list of major equipment to be used.
- 3.1.2 The Contractor shall submit shop drawings for all Helical Pile components, including corrosion protection and pile top attachment to the Owner for review and approval. This includes Helical Pile lead/starter and extension section identification (manufacturer's catalog numbers).
- 3.1.3 The Contractor shall submit certified mill test reports for the central steel shaft, as the material is delivered, to the Owner for record purposes. The ultimate strength, yield strength, % elongation, and chemistry composition shall be provided.
- 3.1.4 The Contractor shall submit to the Owner copies of calibration reports for each torque indicator or torque motor, and all load test equipment to be used on the project. The calibration tests shall have been performed within forty five (45) working days of the date submitted. Helical Pile installation shall not proceed until the Owner has received the calibration reports. These calibration reports shall include, but are not limited to, the following information:
 - 3.1.4.a Name of project and Contractor
 - 3.1.4.b Name of testing agency
 - 3.1.4.c Identification (serial number) of device calibrated
 - 3.1.4.d Description of calibrated testing equipment
 - 3.1.4.e Date of calibration
 - 3.1.4.f Calibration data

3.1.5 Work shall not begin until all the submittals have been received and approved by the Owner. The Contractor shall allow the Owner a reasonable time to review, comment, and return the submittal package after a complete set has been received. All costs associated with incomplete or unacceptable submittals shall be the responsibility of the Contractor.

3.2 Installation Records

The Contractor shall provide the Owner copies of Helical Pile installation records within 24 hours after each installation is completed. These installation records shall include, but are not limited to, the following information.

- 3.2.1 Name of project and Contractor
- 3.2.2 Name of Contractor's supervisor during installation
- 3.2.3 Date and time of installation
- 3.2.4 Name and model of installation equipment
- 3.2.5 Type of torque indicator used
- 3.2.6 Location of Helical Pile by assigned identification number
- 3.2.7 Actual Helical Pile type and configuration – including lead section (number and size of helix plates), number and type of extension sections (manufacturer's SKU numbers)
- 3.2.8 Helical Pile installation duration and observations
- 3.2.9 Total length of installed Helical Pile
- 3.2.10 Cut-off elevation
- 3.2.11 Inclination of Helical Pile
- 3.2.12 Installation torque at one-foot intervals for the final 10 feet
- 3.2.13 Comments pertaining to interruptions, obstructions, or other relevant information
- 3.2.14 Rated load capacities

3.3 Closeout Submittals

- 3.3.1 Warranty: Warranty documents specified herein
 - 3.3.1.a Project Warranty: Refer to Conditions of the Contract for project warranty provisions

Warranty Period: Two years commencing on date of Substantial Completion
 - 3.3.1.b Manufacturer's Warranty: Submit, for Owner's Acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights the Owner may have under Contract Document.

4 PRODUCTS AND MATERIALS

4.1 Central Steel Shaft:

- 4.1.1 *4-1/2" OD Material*: Shall be structural steel tube or pipe, seamless or straight-seam welded, per ASTM A500 or A513. Wall thickness is 0.337" (schedule 80).
 - 4.1.1.a Torque strength rating = 23,000 ft-lb
 - 4.1.1.b Minimum yield strength = 50 ksi

4.2 Helix Bearing Plates:

Shall be hot rolled carbon steel sheet, strip, or plate formed on matching metal dies to true helical shape and uniform pitch. Bearing plate material shall conform to the following ASTM specifications.

4.2.1 Per ASTM A572 or A1018 or A656 with minimum yield strength of 50 ksi. Plate thickness as required.

4.3 Bolts:

The size and type of bolts used to connect the central steel shaft sections together shall conform to the following ASTM specifications.

4.3.1 ASTM A325

4.4 Couplings:

The couplings shall either be formed as an integral part of the plain and helical extension material as hot forge expanded sockets, or as internal sleeve wrought steel connectors. The steel connectors can be either tubing or solid steel bar with holes for connecting shaft sections together.

4.5 Plates, Shapes, or Pile Caps:

Depending on the application, the pile cap shall be a welded assembly consisting of structural steel plates and shapes designed to fit the pile and transfer the applied load. Structural steel plates and shapes shall conform to ASTM A36.

4.6 Corrosion Protection:

4.6.1 Galvanization: All material shall be hot-dipped galvanized in accordance with ASTM A153 or A123 as specified after fabrication.

5 EXECUTION

5.1 Site Conditions

5.1.1 Prior to commencing Helical Pile installation, the Contractor shall inspect the work of all other trades and verify that all said work is completed to the point where Helical Piles may commence without restriction.

5.1.2 The Contractor shall verify that all Helical Piles may be installed in accordance with all pertinent codes and regulations regarding such items as underground obstructions, right-of-way limitations, utilities, etc.

5.1.3 In the event of a discrepancy, the Contractor shall notify the Owner. The Contractor shall not proceed with Helical Pile installation in areas of discrepancies until said discrepancies have been resolved.

5.2 Installation Equipment

5.2.1 Shall be rotary type, hydraulic power driven torque motor with clockwise and counter-clockwise rotation capabilities. The torque motor shall be capable of continuous adjustment to revolutions per minute (RPM's)

during installation. Percussion drilling equipment shall not be permitted. The torque motor shall have torque capacity 15% greater than the torsional strength rating of the central steel shaft to be installed.

Helical Piles should be installed with high torque, low RPM torque motors, which allow the helical screw plates to advance with minimal soil disturbance.

5.2.2 Equipment shall be capable of applying adequate down pressure (crowd) and torque simultaneously to suit project soil conditions and load requirements. The equipment shall be capable of continuous position adjustment to maintain proper Helical Pile alignment.

5.3 Installation Tooling

5.3.1 A torque indicator shall be used during Helical Pile installation. The torque indicator can be an integral part of the installation equipment or externally mounted in-line with the installation tooling.

5.3.1.a Shall be capable of providing continuous measurement of applied torque throughout the installation.

5.3.1.b Shall be capable of torque measurements in increments of at least 500 ft-lb

5.3.1.c Shall be calibrated prior to pre-production testing or start of work. Torque indicators which are an integral part of the installation equipment, shall be calibrated on-site. Torque indicators which are mounted in-line with the installation tooling, shall be calibrated either on-site or at an appropriately equipped test facility. Indicators that measure torque as a function of hydraulic pressure shall be calibrated at normal operating temperatures.

5.3.1.d Shall be re-calibrated, if in the opinion of the Owner and/or Contractor reasonable doubt exists as to the accuracy of the torque measurements.

5.4 Installation Procedures

5.4.1 Central Steel Shaft: (Lead and Extension Sections)

5.4.1.a The Helical Pile installation technique shall be such that it is consistent with the geotechnical, logistical, environmental, and load carrying conditions of the project.

5.4.1.b The lead section shall be positioned at the location as shown on the working drawings. Battered Helical Piles can be positioned perpendicular to the ground to assist in initial advancement into the soil before the required batter angle shall be established. The Helical Pile sections shall be engaged and advanced into the soil in a smooth, continuous manner at a rate of rotation of 5 to 20 RPM's. Extension sections shall be provided to obtain the required minimum overall length and installation torque as shown on the working drawings. Connect sections together using coupling bolt(s) and nut torqued to 40 ft-lb.

5.4.1.c Sufficient down pressure shall be applied to uniformly advance the Helical Pile sections approximately 3 inches per revolution. The rate of rotation and magnitude of down pressure shall be adjusted for different soil conditions and depths.

5.5 Termination Criteria

5.5.1 The torque as measured during the installation shall not exceed the torsional strength rating of the central steel shaft.

- 5.5.2 The minimum installation torque and minimum overall length criteria as shown on the working drawings shall be satisfied prior to terminating the Helical Pile installation.
- 5.5.3 If the torsional strength rating of the central steel shaft and/or installation equipment has been reached prior to achieving the minimum overall length required, the Contractor shall have the following options:
- 5.5.3.a Terminate the installation at the depth obtained subject to the review and acceptance of the Owner, or:
- 5.5.3.b Remove the existing Helical Pile and install a new one with fewer and/or smaller diameter helix plates. The new helix configuration shall be subject to review and acceptance of the Owner. If re-installing in the same location, the top-most helix of the new Helical Pile shall be terminated at least (3) three feet beyond the terminating depth of the original Helical Pile.
- 5.5.4 If the minimum installation torque as shown on the working drawings is not achieved at the minimum overall length, and there is no maximum length constraint, the Contractor shall have the following options:
- 5.5.4.a Install the Helical Pile deeper using additional extension sections, or:
- 5.5.4.b Remove the existing Helical Pile and install a new one with additional and/or larger diameter helix plates. The new helix configuration shall be subject to review and acceptance of the Owner. If re-installing in the same location, the top-most helix of the new Helical Pile shall be terminated at least (3) three feet beyond the terminating depth of the original Helical Pile.
- 5.5.4.c De-rate the load capacity of the Helical Pile and install additional Helical Pile(s). The de-rated capacity and additional Helical Pile location shall be subject to the review and acceptance of the Owner.
- 5.5.5 If the Helical Pile is refused or deflected by a subsurface obstruction, the installation shall be terminated and the pile removed. The obstruction shall be removed, if feasible, and the Helical Pile re-installed. If the obstruction can't be removed, the Helical Pile shall be installed at an adjacent location, subject to review and acceptance of the Owner.
- 5.5.6 If the torsional strength rating of the central steel shaft and/or installation equipment has been reached prior to proper positioning of the last plain extension section relative to the final elevation, the Contractor may remove the last plain extension and replace it with a shorter length extension. If it is not feasible to remove the last plain extension, the Contractor may cut said extension shaft to the correct elevation. The Contractor shall not reverse (back-out) the Helical Pile to facilitate extension removal.
- 5.5.7 The average torque for the last three feet of penetration shall be used as the basis of comparison with the minimum installation torque as shown on the working drawings. The average torque shall be defined as the average of the last three readings recorded at one-foot intervals.

6 MEASUREMENT AND PAYMENT

- ◆ *Per Helical Pile with Add/Deduct*: Helical Piles meeting the design capacity shall be paid for on a “per foundation” basis, with a predetermined length, and an add/deduct amount per lineal foot to accommodate field changes.

END OF SPECIFICATION

HELICAL PILES FOR STRUCTURAL SUPPORT

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ASSAWOMAN CANAL TRAIL – PHASE 1
DNREC Contract #: 11-PS-02

APPENDIX

ASSAWOMAN CANAL TRAIL – PHASE 1
DNREC Contract #: 11-PS-02

APPENDIX A

GEOTECHNICAL REPORT

1277 McD Drive
Dover, Delaware 19901
Local 302-744-9855
Fax 302-744-9160
Toll Free 888-867-3134
www.hcea.com

**Assawoman Canal Trail
Geotechnical Engineering Study
Project No. D13064**

Prepared For:

Mr. Dean Holden
Becker Morgan Group
Port Exchange
312 W. Main Street
Salisbury, Maryland 21801

Prepared By:
Hillis-Carnes Engineering Associates, Inc.
1277 McD Drive
Dover, Delaware 19901

July 18, 2013

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Reference: Assawoman Canal Trail
Ocean View, Delaware
HCEA Project No. D13064

Dear Mr. Holden:

Hillis-Carnes Engineering Associates, Inc. (HCEA) is pleased to submit this report concerning the subsurface exploration and subsequent geotechnical evaluation for the proposed trail project and associated facilities located in Ocean View, Delaware.

We wish to advise you that the boring samples will be stored at our Dover, Delaware office for a period of 30 days from the date of this letter. Should you wish that the samples be stored for a longer period of time or be delivered to you or another party, please advise us in writing prior to the end of the 30-day period. The samples will be discarded at the end of the 30-day storage period.

HCEA appreciates having had the opportunity to provide geotechnical services and will remain available for further consultation during the various design stages. Should there be any questions concerning the contents of the report, the requirement of additional consultation, design, inspection or testing services, please contact the Dover HCEA office.

Very truly yours,
HILLIS-CARNES ENGINEERING ASSOCIATES, INC.



Jeremy M. Boehm, P.E.
Project Engineer

A handwritten signature in black ink, appearing to read "Fernando Garcia".

Fernando García
Chief Engineer

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GEOTECHNICAL ENGINEERING STUDY
ASSAWOMAN CANAL TRAIL
OCEAN VIEW, DELAWARE
HCEA JOB NO. D13064

1.0 PURPOSE AND SCOPE

The purpose of this study was to determine the general subsurface conditions at the boring locations and to evaluate those conditions with respect to the concept and design of a trail project and associated facilities parallel to the Assawoman Canal in Ocean View, Delaware.

HCEA developed the evaluations and recommendations presented in this report from an analysis of project characteristics and an interpretation of the general subsurface conditions at the site based on the boring information. The stratification lines indicated on the boring logs represent the approximate boundaries between soil types. In-situ the transitions may be gradual. Such variations can best be evaluated during construction and any minor design changes can be made at that time.

An evaluation of the site with respect to potential construction problems and recommendations dealing with the earthwork and inspection during construction are also included. Such an inspection is considered necessary to verify the subsurface conditions and to verify that the soils-related construction phases are performed properly.

The *Appendix* contains a summary of the field work on which this report is based.

2.0 PROJECT CHARACTERISTICS

The project site is located on the north bank of the Asswoman Canal between White Creek and Garfield Parkway in Ocean View, Delaware. Refer to the Project Location Map (Figure 1) in the *Appendix* for the approximate project vicinity.

The proposed construction includes a recreational trail between Garfield Parkway and Ocean View Marina. A variety of finish surfaces are being considered for the trail, including compacted well-graded crushed stone (stone with fines) or hot-mix asphalt. The project also includes the construction of the pedestrian bridge, gazebo, public restrooms, and paved parking at the Town Road Property, approximately 800 feet northwest of Garfield Parkway. A kayak launch with a bulkhead is also being considered for the lagoon at the Town Road Property.

If any of the project characteristics, structural loading conditions or required settlement criteria differ from those outlined above, our office should be contacted for a re-evaluation of the site.

3.0 FIELD EXPLORATION

In order to gain information as to the properties of the existing native soils, HCEA performed twelve (12) hand auger borings along the proposed project alignment. Hand auger borings HA-1 through HA-10 were performed along the approximate trail

alignment and were advanced to depths of 6 feet or until running sands were encountered. Hand auger borings HA-11 and HA-12 were performed in the proposed parking area at the Town Road Property and were advanced to depths of 5 feet. Boring B-2 was proposed as an SPT boring, but was completed as a hand auger due to accessibility limitations. Hand auger boring was advanced to a depth of 7 feet. Standard penetration test (SPT) boring B-1 was advanced to a depth of 35 feet at the proposed pedestrian bridge location. Borings B-3 through B-8 were drilled to depths of 15 or 20 feet at the proposed bulkhead, gazebo, and public restroom locations. The approximate boring locations are also shown on the Boring Location Plan (Figure 2) in the *Appendix* of this report.

HCEA sampled the hand auger borings at 1 foot intervals. HCEA advanced the SPT borings with hollow-stem augers and sampled at 2.5 foot intervals in the upper 10 feet and at 5.0 foot intervals thereafter. Samples were taken by driving a 1-3/8 inch I.D. (2-inch O.D.) split-spoon sampler in accordance with ASTM D-1586 specifications. The sampler was first seated 6 inches to penetrate any loose cuttings and then was driven an additional foot with blows of a 140 pound hammer falling 30 inches, imparting 350 foot-pounds of kinetic energy to the soil. The number of hammer blows required to drive the sampler from 6 inches to 18 inches of penetration is the "penetration resistance" or "N" value. The penetration resistance, when properly evaluated, is an index of the soil strength and compressive characteristics.

Representative portions of each soil sample were placed in containers and transported to HCEA's laboratory. In the lab, a Geotechnical Engineer classified the samples in accordance with the Unified Soil Classification System (USCS). The USCS symbols appear on the boring logs and the system nomenclature is briefly described in the Appendix.

HCEA performed laboratory testing on selected samples to assist with the evaluation of the subsurface materials. Three (3) grain size analyses and one Atterberg limits determination were performed on samples recovered from the SPT borings. A grain size analysis and a California Bearing Ratio (CBR) test were performed on a bulk sample obtained from the Town Road Property. Laboratory test results are noted on the Particle Size Distribution Reports and the Records of Soil Exploration in the Appendix.

4.0 SUBSURFACE CONDITIONS

Details of the subsurface conditions encountered at the site are shown on the *Records of Soil Exploration* boring logs. We provide a brief description of the subsurface conditions and pertinent engineering characteristics of the in the following sections. We estimated the strata divisions shown on the *Records of Soil Exploration* based on visual examinations of the recovered boring samples. In the field strata changes could occur gradually and/or at slightly different levels than indicated. Groundwater conditions indicated on the *Records of Soil Exploration* are those observed during the period of the subsurface exploration. Groundwater levels could fluctuate seasonally and may also be influenced by changes in grading, runoff, infiltration rates and other environmental factors.

We discuss generalized subsurface conditions based on the results of the borings in the following sections:

4.1 Site Geology

According to the Geologic Map of Southern Delaware, Open File Report No. 32, prepared by the Delaware Geological Survey (DGS) and dated 1990, the area is underlain by the Omar Formation. The Omar Formation is described as white to tan to bluish gray silty fine **sand**, clayey silt and silty clay, and fine to coarse sand. Heterogeneous; lithologic changes occur over short distances laterally and vertically. Lower part of formation very fine sand to clayey silt and silty clay restricted to paleovalley cut into Beaverdam Formation. Unconformably overlain by upper Omar sand, silt, and clay and scattered shell beds. Upper Omar is the major surficial unit in southeastern Sussex County.

4.2 Surficial Materials

Surficial materials included organic bearing soils up to 12 inches in thickness. The thickness of organic bearing soils (topsoil) and other surficial material types may vary across the site.

4.3 Natural Materials

The soils encountered at the borings are consistent with the Omar Formation, overlain by dredge spoils in some locations. Subsurface soils generally consisted of materials classified as silty SAND (SM), poorly graded SAND (SP), and combinations thereof.

"N" values generally indicated very loose to loose relative densities for the upper 5 to 10 feet of granular materials, becoming medium dense with depth. Refer to the *Records of Soil Exploration* for detailed information regarding the densities and consistencies of the soils in the SPT borings.

4.4 Groundwater

We encountered groundwater at depths between 3 and 7 feet below grade during and following drilling operations. The bore holes collapsed at depths between 2.5 and 4 feet below grade following removal of the augers.

A more accurate determination of the hydrostatic water table would require the installation of perforated pipes or piezometers which could be monitored over an extended period of time. The actual level of the hydrostatic water table and the amount and level of perched water may fluctuate throughout the year, contingent upon variations in precipitation, surface run-off, infiltration, site topography and drainage.

5.0 EVALUATIONS AND RECOMMENDATIONS

Our findings suggest that the site can be developed for the proposed structures utilizing conventional spread footings or ground-supported slab construction bearing on natural soils or newly placed engineered fill.

It is particularly important to verify that topsoil and other deleterious surface materials are properly stripped in the grading process, that subgrades are verified for firmness prior to

adding the first lift of new fill, and that all grading operations are continuously monitored for material quality, lift thickness and compaction.

Special consideration should be given to the proper monitoring of fill operations, footing excavations, and concrete placement in all structural areas of the project.

HCEA developed the following recommendations based on the previously described project characteristics and subsurface conditions. If there are any changes to the project characteristics or if different subsurface conditions are encountered during construction, HCEA should be consulted so that the recommendations of this report can be reviewed and revised where necessary.

5.1 General Site Preparation

All existing structures (including all above and below ground construction) within the areas to be developed should be removed prior to the initiation of new construction. We suggest that all available information regarding the existing utilities at the site be reviewed prior to construction.

Removal should include the surficial materials, unsuitable existing fill, and deleterious materials from the areas to be developed. Stripping operations should be performed in a manner consistent with good erosion and sediment control practices.

After the initial stripping process is completed, areas of the site to receive fill, or areas of the site at grade where structures will be located, should be proof rolled. The proof rolling operations should be performed using a 20 ton, fully loaded dump truck or another pneumatic tire vehicle of similar size and weight. The purpose of the proof rolling will be to locate any near surface pockets of soft or loose soils requiring undercutting. An HCEA Geotechnical Engineer or experienced Soils Inspector should witness the proof rolling operations and should determine which areas need further undercutting and/or stabilization.

5.2 Fill Selection, Placement and Compaction

The Geotechnical Engineer should inspect, test, and approve all fill or backfill material. The on-site soils which are free from organic and other deleterious components can be re-used as structural fill. An experienced Soils Inspector can identify materials suitable for various construction purposes during grading operations.

If off-site borrow is required the imported materials should meet or exceed the requirements for structural fill set forth in the project specifications. We recommend that samples of all fill materials be submitted to our laboratory prior to placement to determine their compliance with any necessary material requirements.

Moisture conditioning (that is, wetting or drying) of the soils should be anticipated to achieve proper compaction. The moisture contents of the soils should be controlled properly to avoid extensive construction delays. If imported fill material is required, those materials should have Unified Soil Classifications of SM or better (better meaning fewer quantities of fine grained materials such as silts and clays).

Care should be exercised during the grading operations at the site. The traffic of heavy construction equipment could create pumping and a general deterioration of subgrade soil conditions in the presence of moisture. If it is at all possible, the grading should therefore be carried out during a dry season. Working during dry periods should reduce potential problems associated with excessively wet conditions, although they may not be eliminated. If such problems arise, the Geotechnical Engineer should be consulted for an evaluation of the conditions.

All structural fill should be placed in horizontal 8-inch (maximum) loose lifts and should be compacted to a minimum of 95 percent of the Standard Proctor (ASTM D-698) maximum dry density. Fill materials in landscape and other non-structural areas should be compacted to at least 90 percent of the Modified Proctor maximum dry if significant subsidence of the fill under its own weight is to be avoided. Field moisture contents should be maintained within +/-2 percentage points of the optimum moisture content in order to provide adequate compaction.

Structural fill should extend a minimum of ten feet beyond building lines where floor slabs are to be constructed on the fill. Final slopes should be no steeper than 2(H):1(V). An experienced Engineering Technician should perform testing on a full-time basis to verify that the proper degree of compaction is obtained.

5.3 Foundations

Our findings indicate that the proposed structures can be supported on spread footings bearing on firm natural soils, on new engineered fill placed over natural soils or on a combination thereof. Footings should not be placed on or over any man-placed fill materials that are not properly certified by a Geotechnical Engineer or experienced Soils Inspector based on rigorous inspection and observations with a final approval by an HCEA Geotechnical Engineer during construction.

Based on the boring results and subsequent data analysis, it is the professional opinion of HCEA that the existing natural soils at the proposed pedestrian bridge at the Town Road Property will provide **2,000** pounds per square foot (psf) net allowable bearing capacity. The existing natural soils at the proposed gazebo and restroom areas will provide **3,000** psf net allowable bearing capacity. We estimate total settlements of less than 1 inch, with differential settlements being approximately ½ inch.

All footing excavations should be inspected by a Geotechnical Engineer or experienced Soils Inspector prior to the placement of concrete. The purpose of the inspection would be to verify the exposed materials will be capable of supporting the design bearing pressure. Such an inspection should include bearing tests performed with attention to adequate spacing and hand auguring to identify potential problem areas.

If soft or loose pockets are encountered in the footing excavations the unstable materials should be removed and the footings should be located at a lower elevation. Alternately, the unstable materials could be undercut and replaced with either new fill placed and compacted in accordance with the recommendations of Sections 5.1 and 5.2 of this report, or with lean (500 psi) concrete.

In all areas where foundations will be supported on structural fill the structural fill should extend a sufficient distance laterally beyond the perimeters of footings to encompass the zone of influence for the footings. For design purposes, the plans should reflect structural fill extending a minimum distance of 9 inches laterally beyond a footing perimeter for each linear foot of structural fill below the bearing level.

5.4 Bulkhead Soil Parameters

The properties of the existing soil layers in the bulkhead area have been calculated via correlations from the SPT borings. The soil parameters are summarized in the following table.

Soil Layer	Depth Range	Standard Penetration Resistance, N	Angle of Internal Friction, ϕ	Moist Unit Weight, γ	Effective Cohesion, C
1. Loose Sand	0 - 2.5 feet	6	29°	110 lb/ft ³	0
2. Dense Sand	2.5 - 7.5 feet	27	35°	125 lb/ft ³	0
3. Medium Sand	7.5 - 15 feet	11	30°	115 lb/ft ³	0
4. Dense Sand	15 - 20 feet	30	36°	130 lb/ft ³	0

The unit weights, γ , are provided for the drained condition. Unit weights should be adjusted for the worst case groundwater level as shown on Figure 4 in the appendix.

5.5 Frost Protection

Exterior footings and footings in unheated areas should be located at depths of at least 2.5 feet below final exterior grades so as to provide adequate protection from frost heave. If the structure is to be constructed during the winter months, or if the building interior will likely be subjected to freezing temperatures after footing construction, then all footings should be provided with adequate frost cover protection. Otherwise, interior footings can be located on suitable materials at nominal depths (as required by design) below finished floor grade.

5.6 Abutments and Retaining Walls

Backfill immediately behind walls should be granular material containing less than 12 percent passing the No. 200 (0.074 mm) sieve. The compaction behind these walls should be 93 percent of the standard Proctor maximum dry density (ASTM D698). Since excessive compaction may cause yielding or damage to foundations and walls, hand operated equipment should be used near the walls (within a distance of 5 feet or the wall height, whichever is less). Fill placement should otherwise be in accordance with sections 5.1 and 5.2 of this report.

Structural walls designed with restricted or unrestricted rotation at the top of the wall and subjected to lateral earth pressure should be designed to resist an equivalent fluid weight of 65 pcf provided that the backfill is properly drained and meets the requirements specified above. Please refer to Figures 3 and 4 in the appendix for soil and surcharge distribution requirements.

The lateral earth pressure intensity is based on long term soil loading conditions using an at-rest lateral coefficient of 0.5. On-site soils or borrow materials classified as SP in accordance with the USCS should be used to backfill behind permanent retaining walls. For SP materials compacted in place, applicable engineering characteristics suitable for design are as follows:

Cohesion	zero
Angle of Internal Friction	30°
Coefficient of sliding friction between cast-in place footing and subgrade	0.35
Maximum moist density, compacted backfill	125 pcf
Active earth coefficient, K_a	0.33
At rest earth coefficient, K_0	0.50
Passive earth coefficient, K_p	3.20

For passive pressure resistance against cast-in-place formed wall or footing elements, and passive pressure coefficient of 3.0 may be used for a level grade. A minimum factor of safety of 1.5 should be applied to all passive pressure calculations.

5.7 Pavements

The layer of material directly beneath the existing topsoil at the Town Road Property consists of silty or clayey SANDs (USCS SM or SC, AASHTO A-2-4 or A-2-6). A composite CBR sample was obtained from locations HA-11 and HA-12 and tested to yield a value of 17.4%. The CBR value was factored by 2/3 for a design CBR of 12%.

Based on the encountered soil conditions, and an assumed Average Daily Traffic (ADT) of less than 1,000 vehicles with 1% trucks, we recommend a light duty pavement section consisting of 1 ½ inches of Type “C” Hot-mix surface course and 3 inches of Type “B” Hot-mix binder course over 6 inches of graded aggregate base course. Assuming that pavement subgrades are properly prepared, this pavement section should be adequate for typical automobile traffic. The pavement subgrade and base course should be compacted to a minimum of 95% of the Standard Proctor maximum dry density at moisture contents within ±2% of optimum.

5.8 Ground-Supported Slabs

Floor slabs should be supported on approved, firm natural soils or on newly compacted fill. The slab subgrade should be prepared in accordance with the procedures outlined in Sections 5.1 and 5.2 of this report. Particular attention should be paid to the slab

subgrade, which should be proofrolled to delineate any soft or loose areas requiring undercutting and/or stabilization.

HCEA recommends that the slabs be directly supported on a minimum 4 inch layer of clean granular materials such as washed sand, clean sand and gravel, or screened, crushed stone. A suitable moisture vapor barrier (polyethylene sheeting) should also be provided, if intrusion of water vapor into the structure through the floor slab is to be avoided. These procedures will provide a moisture break that will help to prevent capillary rise, dampness of the floor slabs, and also help to provide a good curing environment for the concrete. HCEA recommends that construction joints on the slab surface and isolation joints between the slab and structural walls be provided (such that the slab would “float” independently of the footings).

A composite modulus of subgrade reaction value “k” of 100 pci can be assumed for floor slabs founded on compact silty sand (SM) or clayey sand (SC) soil approved for concrete placement by HCEA.

5.9 Groundwater and Drainage

We encountered groundwater at depths between 3 and 7 feet below grade in the soil borings.

Adequate drainage should be provided at the site throughout construction to minimize any increases in the moisture contents of structural subgrade soils. Any water infiltration resulting from precipitation or surface run-off should be able to be controlled by means of sump pits and pumps, or by gravity ditching procedures if it is only necessary to lower the water by a minimal amount (on the order of 1± foot to 2± feet, or less). If any conditions are encountered which cannot be handled in such a manner, the Geotechnical Engineer should be consulted.

6.0 RECOMMENDED ADDITIONAL SERVICES

Additional soil and foundation engineering, testing and consulting services recommended for this project are summarized below:

Site Preparation: A Geotechnical Engineer or experienced Soils Inspector should inspect the site prior to the start of final grading. The inspector should determine if any undercutting or in-place densification is necessary to prepare a subgrade for fill placement or for slab support.

Fill Placement and Compaction: A Geotechnical Engineer or experienced Soils Inspector should witness any required filling operations and should take sufficient in-place density tests to verify that the specified degree of fill compaction is achieved. He should observe and approve borrow materials used and should determine if their existing moisture contents are acceptable.

Footing Excavation Inspections: A Geotechnical Engineer or an experienced Soils Inspector should inspect footing excavations prior to pouring the foundation. It is necessary to verify that the design bearing pressure criteria has been achieved and that no loose pockets exist beneath the bearing surfaces of the footing excavations. Based on

the inspection, the Inspector would either approve the bearing surfaces or recommend that loose or soft soils be undercut to expose satisfactory bearing materials. Particular care should be exercised for footings bearing on existing man-placed fill materials.

7.0 REMARKS

This report has been prepared to aid in the evaluation of the site for the proposed construction. It is considered that adequate recommendations have been provided to serve as a basis for design of plans and specifications. Additional recommendations can be provided as needed.

These analyses and recommendations are based on the information made available at the time of writing the report as relevant to on-site conditions including surface and subsurface existing at the time the exploratory borings were drilled. Further assumption has been made that the limited exploratory borings in relation both to the area of the site and to depth are representative of conditions across the site. The recommendations contained herein have been based on a series of widely spaced soil borings. Actual subsurface conditions encountered could vary from those outlined in this report.

If subsurface conditions are encountered which differ from those reported herein, this office should be notified immediately so that the analyses and recommendations can be reviewed and/or revised as necessary. It is also recommended that:

1. We are given the opportunity to review any existing man-placed fill certifications, plans and specifications prepared subsequent to the final geotechnical study in order to comment on the interaction of the soil conditions as described herein and the design requirements.
2. A Geotechnical Engineer or experienced Soils Inspector is present at the site during the construction phase to verify installation according to the approved plans and specifications. Such a presence of an inspector is particularly important during excavation, placement, and compaction of fill materials.

Please note that successful completion of the project is dependent on the compliance with all of the recommendations provided in this report. While represented separately, the recommendations represent work that is intertwined. The successful completion of the project is specifically conditioned on your complying with all recommendations.

Our professional services have been performed, our findings obtained and our recommendations prepared in accordance with generally accepted engineering principles and practices. This warranty is in lieu of all other warranties either implied or expressed. Hillis-Carnes Engineering Associates, Inc. assumes no responsibility for interpretations made by others based on work or recommendations made by HCEA.

ATTACHMENTS

Figure 1: Site Location Map

Figure 2: Boring Location Plan

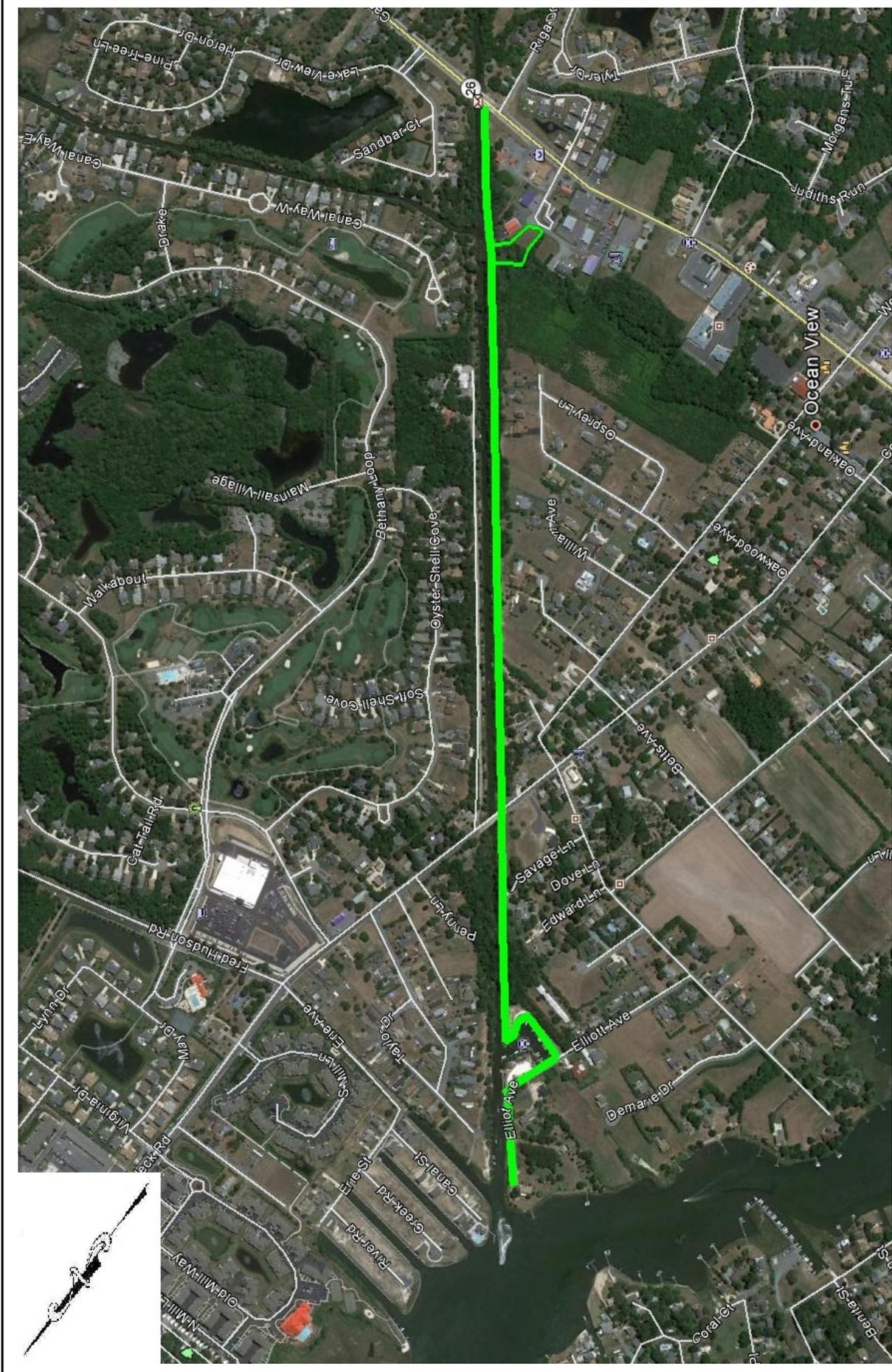
Figure 3: Drained Retaining Walls

Figure 4: Undrained Retaining Walls

Records of Soil Exploration

Laboratory Test Results

Field Classification Sheet



HILLIS - CARNES

ENGINEERING ASSOCIATES, INC.

1277 McD Drive
 Dover, DE 19901
 PHONE: (302) 744-9855
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PROJECT LOCATION MAP

FIGURE 1

Assawoman Canal Trail
 Ocean View, Delaware

JOB No:	D13064	DESIGN BY:	Google
DATE:	7/15/2013	DRAWN BY:	Google
SCALE:	NTS	CHECKED BY:	JMB
PAGE:	1		



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 Dover, DE 19901
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BORING LOCATION PLAN

FIGURE 2

Assawoman Canal Trail
 Ocean View, Delaware

JOB No: D13064

DESIGN BY: Google

DATE: 7/15/2013

DRAWN BY: Google

SCALE: NTS

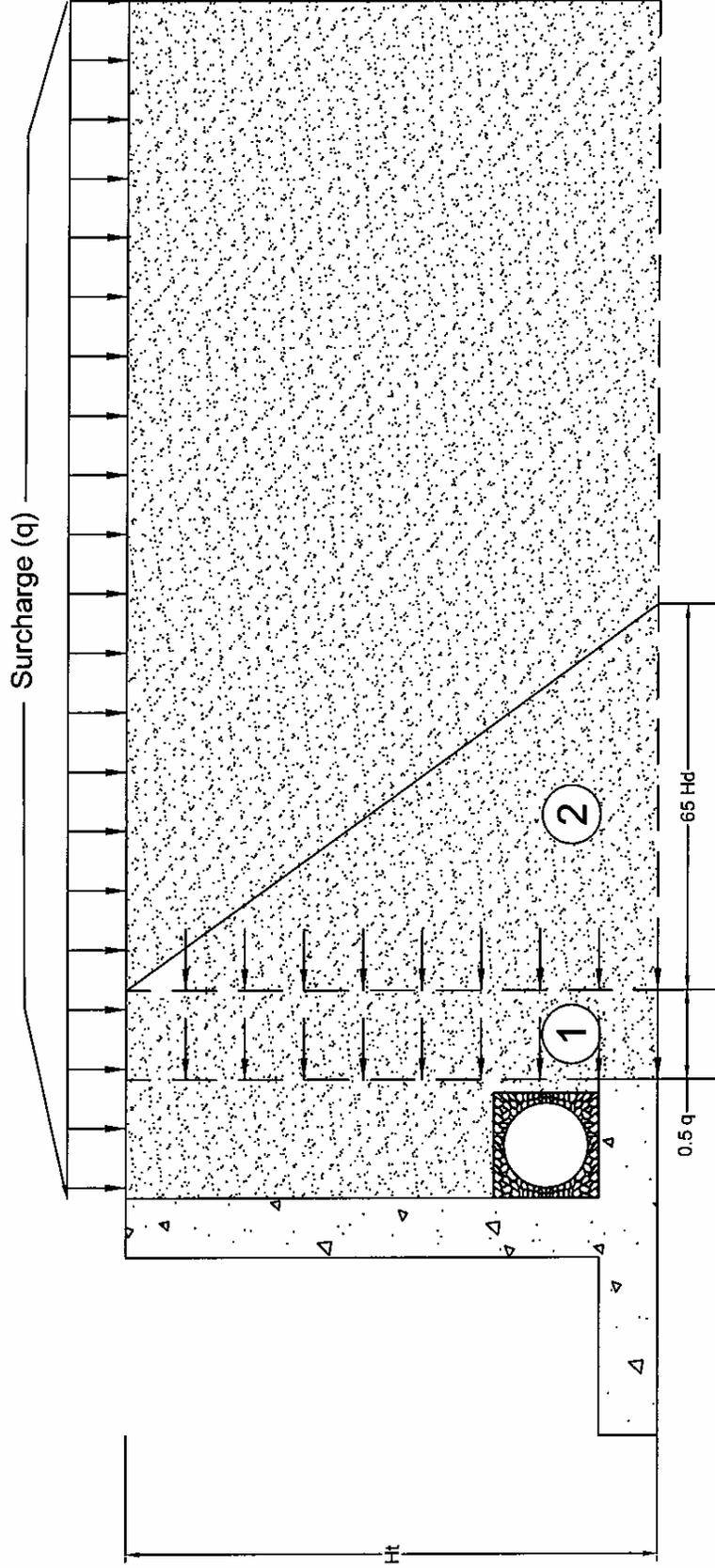
PAGE: 1

CHECKED BY: JMB



H I L L I S - C A R N E S ENGINEERING ASSOCIATES, INC. 1277 McD Drive Dover, DE 19901 PHONE: (302) 744-9855 FAX: (302) 744-9160	BORING LOCATION PLAN FIGURE 2 Assawoman Canal Trail Ocean View, Delaware		JOB No: D13064 DATE: 7/15/2013 SCALE: NTS PAGE: 2	DESIGN BY: Google DRAWN BY: Google CHECKED BY: JMB

EARTH PRESSURE DIAGRAMS FOR PERMANENT RETAINED WALLS DRAINED CONDITION

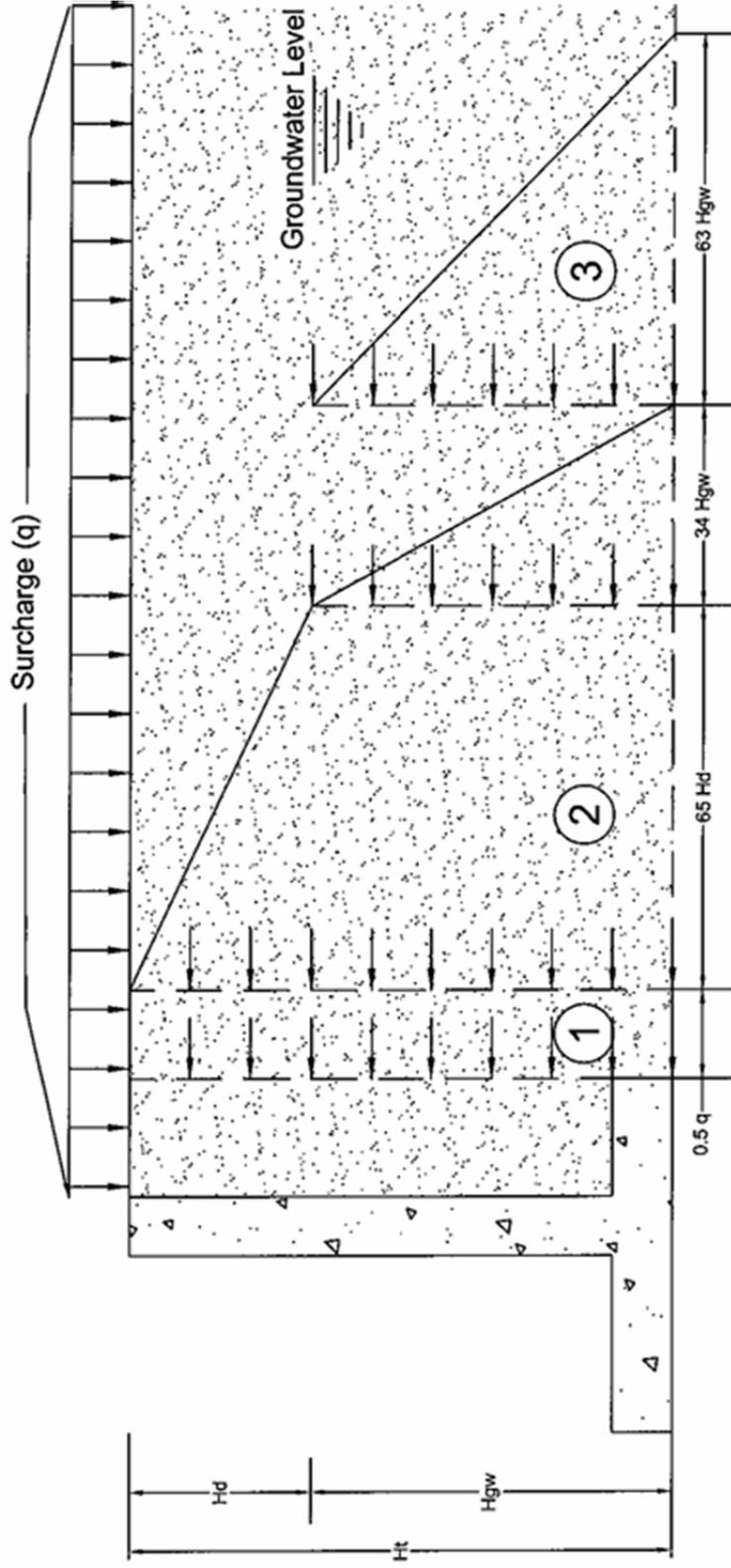


- ① Lateral Surcharge
 - ② Lateral Soil Pressure
 - ③ Hydrostatic Pressure
- Ht Total high
- Pressure diagram for drained condition
 - Pressure diagram for at rest pressures on walls with one support level
 - Backfill behind the wall is granular material SP, SW, GP, GW, SP-SM
 - Backfill should be compacted at 95 percent of maximum dry density (ASTM D 698)
 - Within 10 feet of the walls only light equipment should be used
 - Surcharge q should consider the maximum expected live and permanent loads

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ENGINEERING ASSOCIATES, INC.		DATE: 7/15/2013	DRAWN BY: FGM
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FAX: (302) 744-9160		CHECKED BY: JMB	

DRAINED RETAINING WALLS
FIGURE 3
Assawoman Canal Trail
Ocean View, Delaware

EARTH PRESSURE DIAGRAMS FOR PERMANENT RETAINED WALLS UNDRAINED CONDITION



- ① Lateral Surcharge
 - ② Lateral Soil Pressure
 - ③ Hydrostatic Pressure
- H_d Wet or dry soil high
- Pressure diagram for undrained condition
 - Pressure diagram for at rest pressures on walls with one support level
 - Backfill behind the wall is granular material SP, SW, GP, GW, SP-SM
 - Backfill should be compacted at 95 percent of maximum dry density (ASTM D 698)
 - Within 10 feet of the walls only light equipment should be used
 - Surcharge q should consider the maximum expected live and permanent loads

HILLIS - CARNES ENGINEERING ASSOCIATES, INC.	UNDRAINED RETAINING WALLS		JOB No:	D13064	DESIGN BY:	FGM
	FIGURE 4 Assawoman Canal Trail Ocean View, Delaware		DATE:	7/15/2013	DRAWN BY:	FGM
1277 McD Drive Dover, DE 19901 PHONE: (302) 744-9855			SCALE:	NTS	CHECKED BY:	JMB
			PAGE:	1		

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Assawoman Canal Trail
 Location Bethany Beach, DE
 Job Number D13064
 Boring Number B-1

SAMPLER

Datum _____ Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman K Hastings
 Surf. Elev. _____ ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 6/27/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 6/27/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS SAMPLE TYPE	CON	SAMPLE Blows per 6"			No.	REC.	BORING & SAMPLING NOTES
	Light brown, dry, very loose, fine to coarse SAND, trace silt, trace fine gravel	0		SP	D	1	2	2	1	14	
	Dark Brown, wet, loose, fine to medium SAND, little organic silt			SM	D	2	2	3	2	18	
	Light brown, saturated, medium dense, fine to medium SAND, little silt	5		SM	D	5	13	15	3	18	
	Light brown, saturated, medium dense, fine to coarse SAND, trace silt, trace fine gravel			SP	D	5	7	13	4	18	
		10		SP	D	4	5	11	5	18	
		15		SP	D	5	7	7	6	18	
	Light brown, saturated, medium dense, fine to medium SAND < trace silt	20		SP	D	4	7	6	7	18	
	Light brown and gray, saturated, very loose, fine to medium SAND, little silt	25		SM	D	4	2	2	8	18	

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered 5 ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
4 ft.
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Assawoman Canal Trail
 Location Bethany Beach, DE
 Job Number D13064
 Boring Number B-1

SAMPLER

Datum _____ Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman K Hastings
 Surf. Elev. _____ ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 6/27/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 6/27/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"			No.	REC.	BORING & SAMPLING NOTES
		30		CH	▲	D	2	3	2	9	18	
	Dark brown, saturated, soft to medium, silty CLAY, trace organic silt			CH	▲	D	2	3	3	10	18	
	Boring terminated 35 feet below existing grade.	35										
		40										
		45										
		50										
		55										

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 _____ ft.
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Assawoman Canal Trail
 Location Bethany Beach, DE
 Job Number D13064
 Boring Number B-2

SAMPLER

Datum _____ Hammer Wt. _____ lb. Hole Diameter 4 in. Foreman K Hastings
 Surf. Elev. _____ ft. Hammer Drop _____ in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 6/28/2013 Sampler Diameter _____ in. O.D. Boring Method HA Date Completed 6/28/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLER TYPE	CON	SAMPLE Blows per 6"	No.	REC.	BORING & SAMPLING NOTES
	Brown, dry, fine to medium SAND, little silt	0		SM		D		1		
	Light brown, dry, fine to coarse SAND, trace silt			SP		D		2		
		2.5								
	Brown, moist, fine to medium SAND, trace silt			SP		D		3		
		5								
	Gray, saturated, fine to medium SAND, little organic SILT			SM		D		4		
	Boring terminated 7 feet below existing grade.	7.5								
		10								
		12.5								

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Assawoman Canal Trail
 Location Bethany Beach, DE
 Job Number D13064
 Boring Number B-3

SAMPLER

Datum _____ Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman K Hastings
 Surf. Elev. _____ ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 6/28/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 6/28/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"			No.	REC.	BORING & SAMPLING NOTES
	Brown, moist, loose, fine to medium SAND, little silt	0		SM	▲	D	3	3	4	1	16	Approximately 12 inches of organic bearing soil (topsoil) at surface.
	Gray, wet to saturated, dense to medium dense, fine to medium SAND, trace silt		SP	▲	D	10	15	16	2	18		
		5	SP	▲	D	6	13	16	3	18		
	Light brown, saturated, medium dense, fine to coarse SAND, trace silt		SP	▲	D	6	8	9	4	18		
		10	SP	▲	D	3	5	11	5	18		
	Light brown, saturated, dense, fine to medium SAND, trace silt		SP	▲	D	6	12	20	6	18		
		15	SP	▲	D	7	13	18	7	18		
	Boring terminated 20 feet below existing grade.	20										
		25										

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered 3.5 ft.
 At Completion 3.5 ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
3.75 ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Assawoman Canal Trail
 Location Bethany Beach, DE
 Job Number D13064
 Boring Number B-4

SAMPLER

Datum _____ Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman K Hastings
 Surf. Elev. _____ ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 6/27/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 6/27/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"			No.	REC.	BORING & SAMPLING NOTES
	Brown, moist, loose, fine to medium SAND, little silt	0		SM	▲	D	2	2	3	1	14	Approximately 12 inches of organic bearing soil (topsoil) at surface.
	Light brown, wet, medium dense, fine to coarse SAND, little silt			SM	▲	D	5	10	16	2	18	
		5		SM	▲	D	5	10	13	3	18	
	Light brown, saturated, medium dense to loose, fine to medium SAND, trace silt			SP	▲	D	1	5	6	4	18	
		10		SP	▲	D	1	3	4	5	18	
		15		SP	▲	D	2	4	5	6	18	
	Boring terminated 15 feet below existing grade.											
		20										
		25										

SAMPLER TYPE DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED PT - PRESSED SHELBY TUBE CA - CONTINUOUS FLIGHT AUGER RC - ROCK CORE	SAMPLE CONDITIONS D - DISINTEGRATED I - INTACT U - UNDISTURBED L - LOST	GROUND WATER Encountered <u>3.5</u> ft. At Completion <u>3.25</u> ft. After Auger Removal _____ ft. Backfilled _____ ft.	CAVE IN DEPTH <u>3.5</u> ft. ____ ft. ____ ft. ____ ft.	BORING METHOD HSA - HOLLOW STEM AUGERS CFA - CONTINUOUS FLIGHT AUGERS DC - DRIVING CASING MD - MUD DRILLING
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STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Assawoman Canal Trail
 Location Bethany Beach, DE
 Job Number D13064
 Boring Number B-5

SAMPLER

Datum _____ Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman K Hastings
 Surf. Elev. _____ ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 6/27/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 6/27/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"			No.	REC.	BORING & SAMPLING NOTES
	Brown, moist, loose, fine to coarse SAND, little silt	0		SM	▲	D	2	3	3	1	14	Approximately 10 inches of organic bearing soil (topsoil) at surface.
	Light brown, wet to saturated, medium dense, fine to coarse SAND, trace silt			SP	▲	D	7	11	15	2	18	
		5		SP	▲	D	4	8	11	3	18	
	Light brown, saturated, medium dense, fine to coarse SAND, little silt			SM	▲	D	2	5	6	4	18	
	Light brown, saturated, loose, fine to coarse SAND, trace silt	10		SP	▲	D	1	3	2	5	18	
	Light brown, saturated, medium dense, fine to medium SAND, trace silt	15		SP	▲	D	1	5	8	6	18	
	Boring terminated 15 feet below existing grade.											
		20										
		25										

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Assawoman Canal Trail
 Location Bethany Beach, DE
 Job Number D13064
 Boring Number B-6

SAMPLER

Datum _____ Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman K Hastings
 Surf. Elev. _____ ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 6/27/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 6/27/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"			No.	REC.	BORING & SAMPLING NOTES
0	Brown, moist, loose, fine to medium SAND, little silt	0		SM	▲	D	2	2	3	1	14	Approximately 12 inches of organic bearing soil (topsoil) at surface.
	Light brown, wet, medium dense, fine to medium SAND, trace silt			SP	▲	D	3	11	14	2	18	
5		5		SP	▲	D	4	7	12	3	18	
	Light brown, saturated, loose to very loose, fine to coarse SAND, trace silt			SP	▲	D	3	4	4	4	18	
10		10		SP	▲	D	1	2	2	5	16	
15	Light brown, saturated, loose, fine to coarse SAND, trace silt	15		SP	▲	D	3	4	4	6	18	
	Boring terminated 15 feet below existing grade.											
20												
25												

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Assawoman Canal Trail
 Location Bethany Beach, DE
 Job Number D13064
 Boring Number B-7

SAMPLER

Datum _____ Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman K Hastings
 Surf. Elev. _____ ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 6/27/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 6/27/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"			No.	REC.	BORING & SAMPLING NOTES
0	Light brown, moist, loose, fine to medium SAND, little silt			SM	▲	D	2	2	3	1	12	Approximately 10 inches of organic bearing soil (topsoil) at surface.
	Light brown, wet to saturated, medium dense, fine to medium SAND, trace silt			SP	▲	D	6	10	12	2	18	
5	Light brown, saturated, medium dense, fine to coarse SAND, little silt, trace fine gravel			SM	▲	D	5	10	10	3	18	
				SM	▲	D	4	7	8	4	18	
10				SM	▲	D	3	6	7	5	18	
15	Gray, saturated, medium dense, fine to medium SAND, trace silt			SP	▲	D	6	8	11	6	18	
20	Boring terminated 20 feet below existing grade.			SP	▲	D	3	6	8	7	18	
25												

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered 4.5 ft.
 At Completion 3.75 ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
4 ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Assawoman Canal Trail
 Location Bethany Beach, DE
 Job Number D13064
 Boring Number B-8

SAMPLER

Datum _____ Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman K Hastings
 Surf. Elev. _____ ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 6/27/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 6/27/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"			No.	REC.	BORING & SAMPLING NOTES
	Light brown, moist, loose, fine to medium SAND, trace silt	0		SP	▲	D	2	2	3	1	10	Approximately 12 inches of organic bearing soil (topsoil) at surface.
	Light brown, wet to saturated, medium dense, fine to coarse SAND, trace silt			SP	▲	D	9	13	14	2	18	
		5		SP	▲	D	7	13	16	3	18	
	Light brown, saturated, medium dense, fine to coarse SAND, trace silt			SP	▲	D	5	7	11	4	18	
		10		SP	▲	D	5	7	7	5	18	
		15		SP	▲	D	5	6	9	6	18	
		20		SP	▲	D	6	9	9	7	18	
	Boring terminated 20 feet below existing grade.											
		25										

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion 3.5 ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Assawoman Canal Trail
 Location Bethany Beach, DE
 Job Number D13064
 Boring Number HA-1

SAMPLER

Datum _____ Hammer Wt. _____ lb. Hole Diameter _____ in. Foreman M Frick
 Surf. Elev. _____ ft. Hammer Drop _____ in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 6/21/2013 Sampler Diameter _____ in. O.D. Boring Method HA Date Completed 6/21/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"	No.	REC.	BORING & SAMPLING NOTES
	Dark Brown, moist, fine to medium SAND, little silt, trace fine gravel, trace organics	0		SM		D		1		Approximately 6 inches of organic bearing soil (topsoil) at surface.
				SM		D		2		
	Brown, moist, fine to medium SAND, little silt	2.5		SM		D		3		
	Brown, moist, fine to medium SAND, some clay			SC		D		4		
				SC		D		5		
	Brown, moist, fine to medium SAND, some silt, trace organics	5		SM		D		6		
	Boring terminated 6 feet below existing grade.	7.5								
		10								
		12.5								

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Assawoman Canal Trail
 Location Bethany Beach, DE
 Job Number D13064
 Boring Number HA-2

SAMPLER

Datum _____ Hammer Wt. _____ lb. Hole Diameter _____ in. Foreman M Frick
 Surf. Elev. _____ ft. Hammer Drop _____ in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 6/21/2013 Sampler Diameter _____ in. O.D. Boring Method HA Date Completed 6/21/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"	No.	REC.	BORING & SAMPLING NOTES
0	Brown, moist, fine to medium SAND, trace silt	0		SP		D		1		Approximately 6 inches of organic bearing soil (topsoil) at surface.
				SP		D		2		
2.5	Dark brown, moist, fine to medium SAND, some silt	2.5		SM		D		3		
				SM		D		4		
5	Brown, wet, fine to moist SAND, little silt	5		SM		D		5		
	Boring terminated 5 feet below existing grade due to running sands.									
7.5										
10										
12.5										

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Assawoman Canal Trail
 Location Bethany Beach, DE
 Job Number D13064
 Boring Number HA-3

SAMPLER

Datum _____ Hammer Wt. _____ lb. Hole Diameter _____ in. Foreman M Frick
 Surf. Elev. _____ ft. Hammer Drop _____ in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 6/21/2013 Sampler Diameter _____ in. O.D. Boring Method HA Date Completed 6/21/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLER TYPE	CON	SAMPLE Blows per 6"	No.	REC.	BORING & SAMPLING NOTES
	Brown, moist, fine to medium SAND, trace silt	0		SP				1		Approximately 6 inches of organic bearing soil (topsoil) at surface.
				SP				2		
	Brown, moist, fine to medium SAND, some silt	2.5		SM				3		
				SM				4		
	Boring terminated 4 feet below existing grade due to refusal on tree roots.	5								
		7.5								
		10								
		12.5								

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Assawoman Canal Trail
 Location Bethany Beach, DE
 Job Number D13064
 Boring Number HA-4

SAMPLER

Datum _____ Hammer Wt. _____ lb. Hole Diameter _____ in. Foreman M Frick
 Surf. Elev. _____ ft. Hammer Drop _____ in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 6/21/2013 Sampler Diameter _____ in. O.D. Boring Method HA Date Completed 6/21/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"	No.	REC.	BORING & SAMPLING NOTES
	Light brown, moist, fine to medium SAND, trace silt	0		SP				1		Approximately 6 inches of organic bearing soil (topsoil) at surface.
				SP				2		
	Brown, moist, fine to coarse SAND, little silt	2.5		SM				3		
				SM				4		
	Brown, moist, fine to coarse SAND, some silt, trace fine gravel	5		SM				5		
				SM				6		
	Boring terminated 6 feet below existing grade.	7.5								
		10								
		12.5								

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 _____ ft.
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Assawoman Canal Trail
 Location Bethany Beach, DE
 Job Number D13064
 Boring Number HA-5

SAMPLER

Datum _____ Hammer Wt. _____ lb. Hole Diameter _____ in. Foreman M Frick
 Surf. Elev. _____ ft. Hammer Drop _____ in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 6/21/2013 Sampler Diameter _____ in. O.D. Boring Method HA Date Completed 6/21/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLER TYPE	CON	SAMPLE Blows per 6"	No.	REC.	BORING & SAMPLING NOTES
	Light brown, moist, fine to medium SAND, trace silt	0		SP		D		1		Approximately 6 inches of organic bearing soil (topsoil) at surface.
				SP		D		2		
		2.5		SP		D		3		
				SP		D		4		
				SP		D		5		
	Brown, moist, fine to medium SAND, little silt, trace organics	5		SM		D		6		
	Boring terminated 6 feet below existing grade.	7.5								
		10								
		12.5								

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Assawoman Canal Trail
 Location Bethany Beach, DE
 Job Number D13064
 Boring Number HA-6

SAMPLER

Datum _____ Hammer Wt. _____ lb. Hole Diameter _____ in. Foreman M Frick
 Surf. Elev. _____ ft. Hammer Drop _____ in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 6/21/2013 Sampler Diameter _____ in. O.D. Boring Method HA Date Completed 6/21/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"	No.	REC.	BORING & SAMPLING NOTES
	Brown, moist, fine to medium SAND, little silt, trace fine gravel	0		SM		D		1		Approximately 6 inches of organic bearing soil (topsoil) at surface.
				SM		D		2		
		2.5		SM		D		3		
				SM		D		4		
	Brown, moist, fine to medium SAND, trace silt	5		SP		D		5		
				SP		D		6		
	Boring terminated 6 feet below existing grade.	7.5								
		10								
		12.5								

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Assawoman Canal Trail
 Location Bethany Beach, DE
 Job Number D13064
 Boring Number HA-7

SAMPLER

Datum _____ Hammer Wt. _____ lb. Hole Diameter _____ in. Foreman M Frick
 Surf. Elev. _____ ft. Hammer Drop _____ in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 6/21/2013 Sampler Diameter _____ in. O.D. Boring Method HA Date Completed 6/21/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"	No.	REC.	BORING & SAMPLING NOTES
	Brown, moist, fine to coarse SAND, trace silt	0		SP		D		1		Approximately 6 inches of organic bearing soil (topsoil) at surface.
				SP		D		2		
	Brown, moist, fine to medium SAND, little silt	2.5		SM		D		3		
				SM		D		4		
	Brown, moist, fine to medium SAND, trace fine gravel, trace silt			SM		D		5		
	Brown, moist, medium to coarse SAND, little fine gravel, trace silt	5		SP		D		6		
	Boring terminated 6 feet below existing grade.	7.5								
		10								
		12.5								

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 _____ ft.
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Assawoman Canal Trail
 Location Bethany Beach, DE
 Job Number D13064
 Boring Number HA-8

SAMPLER

Datum _____ Hammer Wt. _____ lb. Hole Diameter _____ in. Foreman M Frick
 Surf. Elev. _____ ft. Hammer Drop _____ in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 6/21/2013 Sampler Diameter _____ in. O.D. Boring Method HA Date Completed 6/21/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"	No.	REC.	BORING & SAMPLING NOTES
	Brown, moist, fine to coarse SAND, little silt, trace fine gravel	0		SM		D		1		Approximately 6 inches of organic bearing soil (topsoil) at surface.
				SM		D		2		
	Brown, wet, fine to coarse SAND, little fine gravel, little silt	2.5		SM		D		3		
				SM		D		4		
	Brown, wet, fine to medium SAND, trace silt, trace fine gravel	5		SP-SM		D		5		
	Brown, wet, fine to medium SAND, trace silt			SP		D		6		
	Boring terminated 6 feet below existing grade.	7.5								
		10								
		12.5								

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Assawoman Canal Trail
 Location Bethany Beach, DE
 Job Number D13064
 Boring Number HA-9

SAMPLER

Datum _____ Hammer Wt. _____ lb. Hole Diameter _____ in. Foreman M Frick
 Surf. Elev. _____ ft. Hammer Drop _____ in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 6/21/2013 Sampler Diameter _____ in. O.D. Boring Method HA Date Completed 6/21/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLER TYPE	CON	SAMPLE Blows per 6"	No.	REC.	BORING & SAMPLING NOTES	
	Organic bearing soil (topsoil)	0		OL				1		Approximately 12 inches of organic bearing soil (topsoil) at surface.	
	Brown, moist, fine to medium SAND, some silt			SM				2			
		2.5		SM				3			
				SM					4		
				SM					5		
	Brown, moist, silty, fine to medium SAND, trace organics	5		SM				6			
	Boring terminated 6 feet below existing grade.	7.5									
		10									
		12.5									

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 _____ ft.
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Assawoman Canal Trail
 Location Bethany Beach, DE
 Job Number D13064
 Boring Number HA-10

SAMPLER

Datum _____ Hammer Wt. _____ lb. Hole Diameter _____ in. Foreman M Frick
 Surf. Elev. _____ ft. Hammer Drop _____ in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 6/21/2013 Sampler Diameter _____ in. O.D. Boring Method HA Date Completed 6/21/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"	No.	REC.	BORING & SAMPLING NOTES
	Brown, moist, fine to coarse SAND, trace fine gravel, trace silt	0		SP		D		1		Approximately 6 inches of organic bearing soil (topsoil) at surface.
	Brown, moist, fine to medium SAND, little silt			SM		D		2		
	Brown, moist, clayey, fine to medium SAND	2.5		SC		D		3		
	Brown, moist, fine to medium SAND, some silt, trace organics			SM		D		4		
	Brown, moist, fine to medium SAND, some silt	5		SM		D		5		
				SM		D		6		
	Boring terminated 6 feet below existing grade.	7.5								
		10								
		12.5								

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 _____ ft.
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Assawoman Canal Trail
 Location Bethany Beach, DE
 Job Number D13064
 Boring Number HA-11

SAMPLER

Datum _____ Hammer Wt. _____ lb. Hole Diameter _____ in. Foreman M Frick
 Surf. Elev. _____ ft. Hammer Drop _____ in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 6/21/2013 Sampler Diameter _____ in. O.D. Boring Method HA Date Completed 6/21/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"	No.	REC.	BORING & SAMPLING NOTES
	Brown, moist, organic bearing soil (topsoil)	0		OL		D		1		Approximately 12 inches of organic bearing soil (topsoil) at surface.
	Gray, moist, fine to medium SAND, some silt, trace fine gravel			SM		D		2		
	Light brown, wet to saturated, fine to medium SAND, trace silt	2.5		SP		D		3		
				SP		D		4		
				SP		D		5		
	Boring terminated 5 feet below existing grade due to running sands.	5								
		7.5								
		10								
		12.5								

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Assawoman Canal Trail
 Location Bethany Beach, DE
 Job Number D13064
 Boring Number HA-12

SAMPLER

Datum _____ Hammer Wt. _____ lb. Hole Diameter _____ in. Foreman M Frick
 Surf. Elev. _____ ft. Hammer Drop _____ in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 6/21/2013 Sampler Diameter _____ in. O.D. Boring Method HA Date Completed 6/21/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"	No.	REC.	BORING & SAMPLING NOTES
0	Brown, wet, fine to medium SAND, some clay			SC		D		1		Approximately 6 inches of organic bearing soil (topsoil) at surface.
				SC		D		2		
2.5	Brown, wet, fine to medium SAND, little silt			SM		D		3		
	Brown, wet to saturated, fine to coarse SAND, trace silt			SP		D		4		
5				SP		D		5		
	Boring terminated 5 feet below grade due to running sands.									
7.5										
10										
12.5										

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

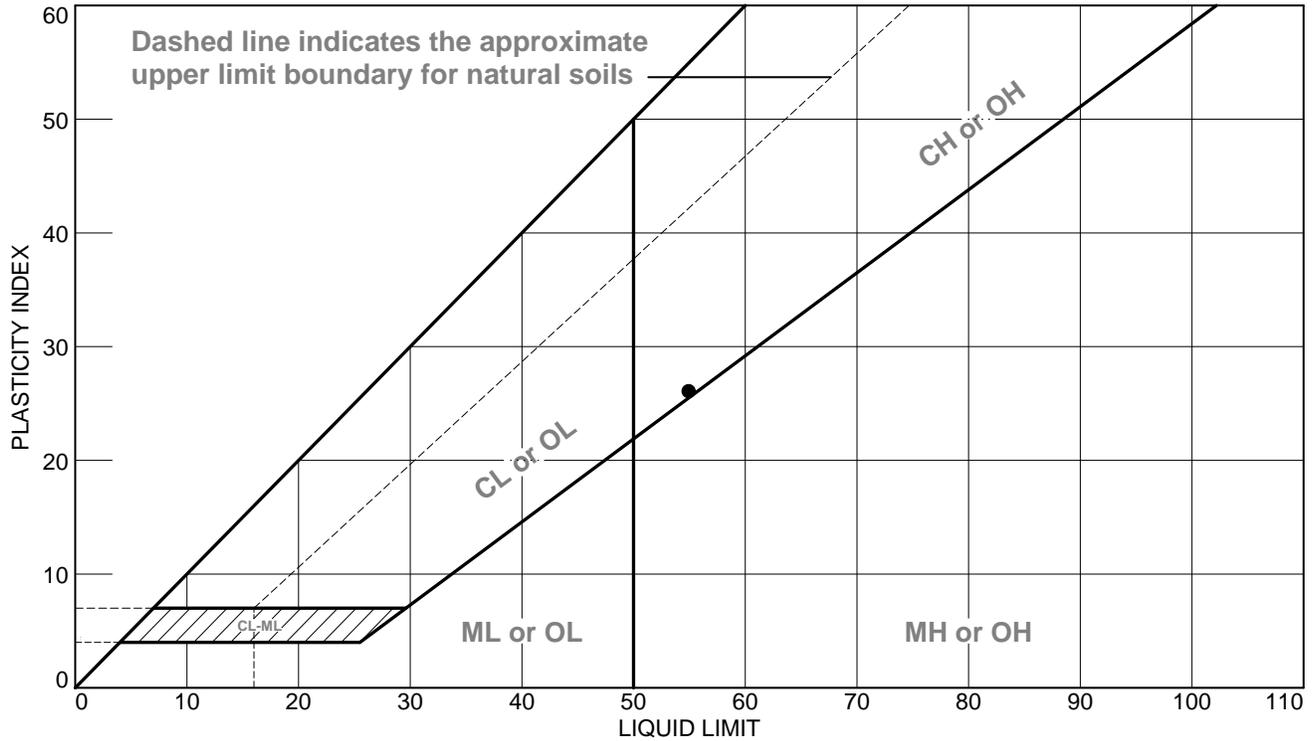
GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	B-1	10	33.5	46.4	29	55	26	CH

HILLIS-CARNES ENGINEERING ASSOCIATES

DOVER, DE

Client: Becker Morgan Group

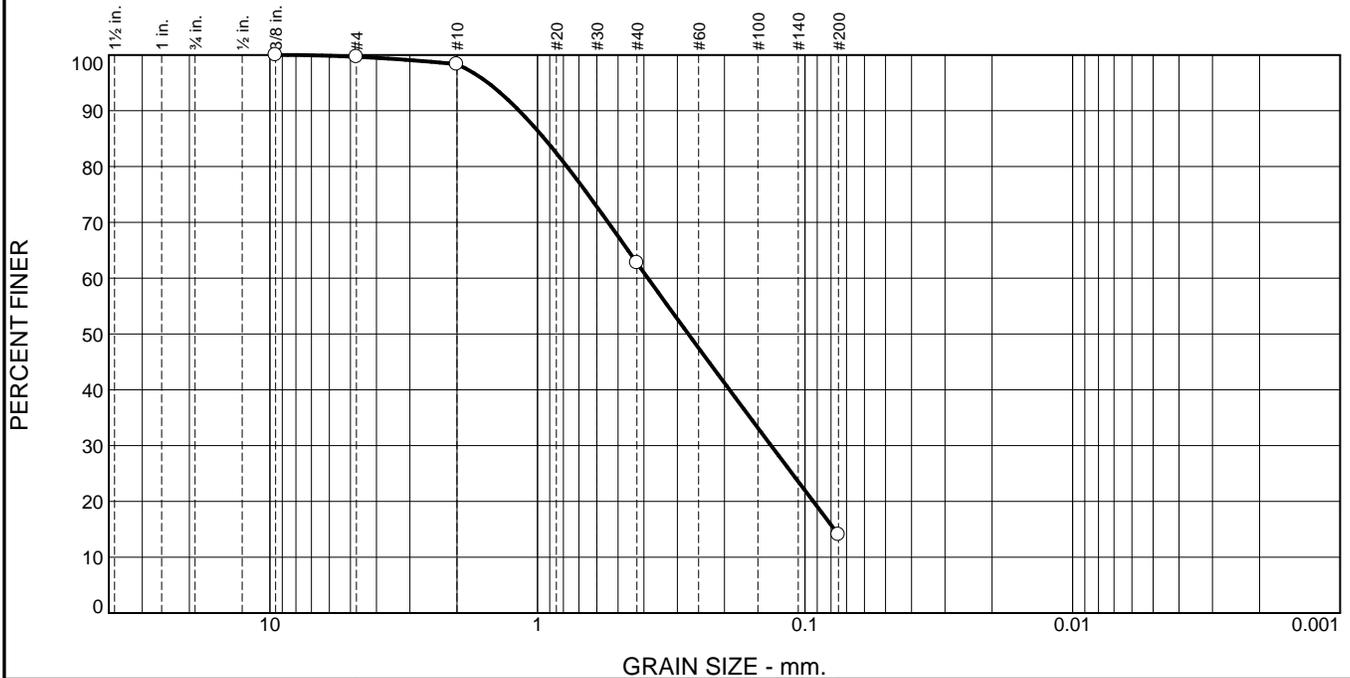
Project: Assawoman Canal Trail

Project No.: D13064

Figure

Tested By: K Kelley Checked By: J Boehm

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.3	1.4	35.5	48.8	14.0	

Test Results (ASTM D 422 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.375	100.0		
# 4	99.7		
# 10	98.3		
# 40	62.8		
# 200	14.0		

* (no specification provided)

Material Description

Light brown, wet, medium dense, fine to coarse SAND, little silt

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SM AASHTO (M 145)= A-2-4(0)

Coefficients

D₉₀= 1.1699 D₈₅= 0.9415 D₆₀= 0.3867
D₅₀= 0.2731 D₃₀= 0.1338 D₁₅= 0.0776
D₁₀= C_u= C_c=

Remarks

natural moisture = 16.7%

Date Received: 6/27/2013 Date Tested: 7/10/2013

Tested By: M Frick

Checked By: J Boehm

Title: Project Engineer

Source of Sample: B-4 Depth: 2.5
Sample Number: 2

Date Sampled: 6/27/2013

HILLIS-CARNES ENGINEERING ASSOCIATES

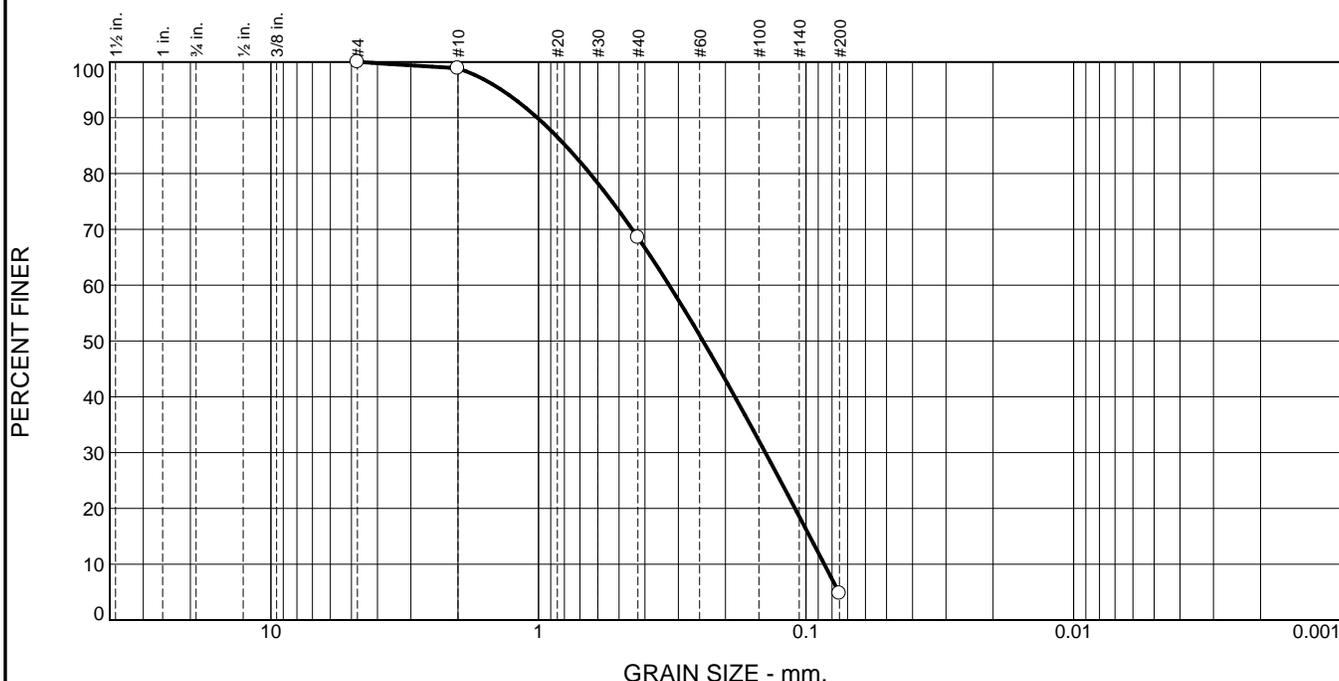
DOVER, DE

Client: Becker Morgan Group
Project: Assawoman Canal Trail

Project No: D13064

Figure

Particle Size Distribution Report



%	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	1.1	30.4	63.7	4.8	

Test Results (ASTM D 422 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
# 4	100.0		
# 10	98.9		
# 40	68.5		
# 200	4.8		

* (no specification provided)

Material Description

Light brown, wet to saturated, medium dense, fine to medium SAND, trace silt

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SP AASHTO (M 145)= A-3

Coefficients

D₉₀= 1.0098 D₈₅= 0.7916 D₆₀= 0.3248
D₅₀= 0.2427 D₃₀= 0.1419 D₁₅= 0.0968
D₁₀= 0.0854 C_u= 3.80 C_c= 0.73

Remarks

natural moisture = 15.2%

Date Received: 6/27/2013 **Date Tested:** 7/10/2013

Tested By: M Frick

Checked By: J Boehm

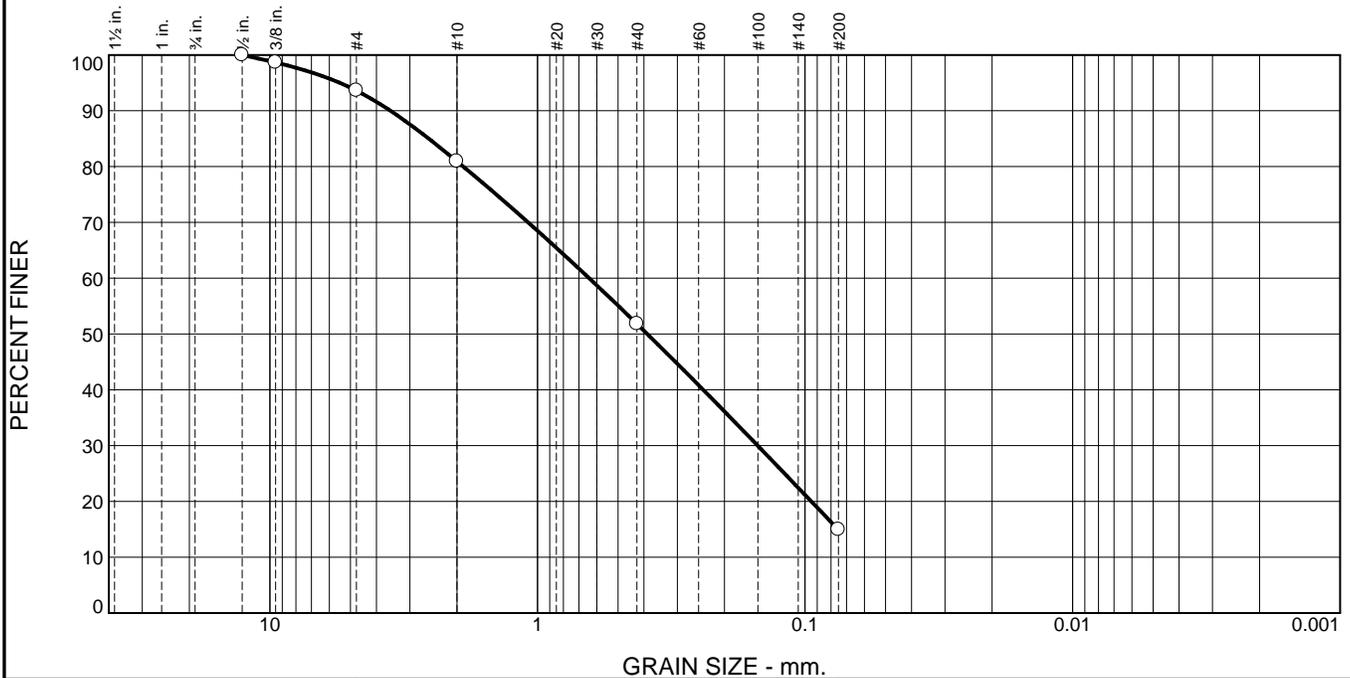
Title: Project Engineer

Source of Sample: B-7 **Depth:** 2.5
Sample Number: 2

Date Sampled: 6/27/2013

HILLIS-CARNES ENGINEERING ASSOCIATES	Client: Becker Morgan Group
DOVER, DE	Project: Assawoman Canal Trail
	Project No: D13064
	Figure

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	6.4	12.7	29.1	36.9	14.9	

Test Results (ASTM D 422 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.5	100.0		
0.375	98.6		
# 4	93.6		
# 10	80.9		
# 40	51.8		
# 200	14.9		

* (no specification provided)

Material Description

Light brown, fine to coarse SAND, little silt, trace fine gravel

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SM AASHTO (M 145)= A-2-4(0)

Coefficients

D₉₀= 3.5447 D₈₅= 2.5487 D₆₀= 0.6409
D₅₀= 0.3887 D₃₀= 0.1503 D₁₅= 0.0752
D₁₀= C_u= C_c=

Remarks

natural moisture = 16.2%

Date Received: 6/28/2013 Date Tested: 7/9/2013

Tested By: M Frick

Checked By: J Boehm

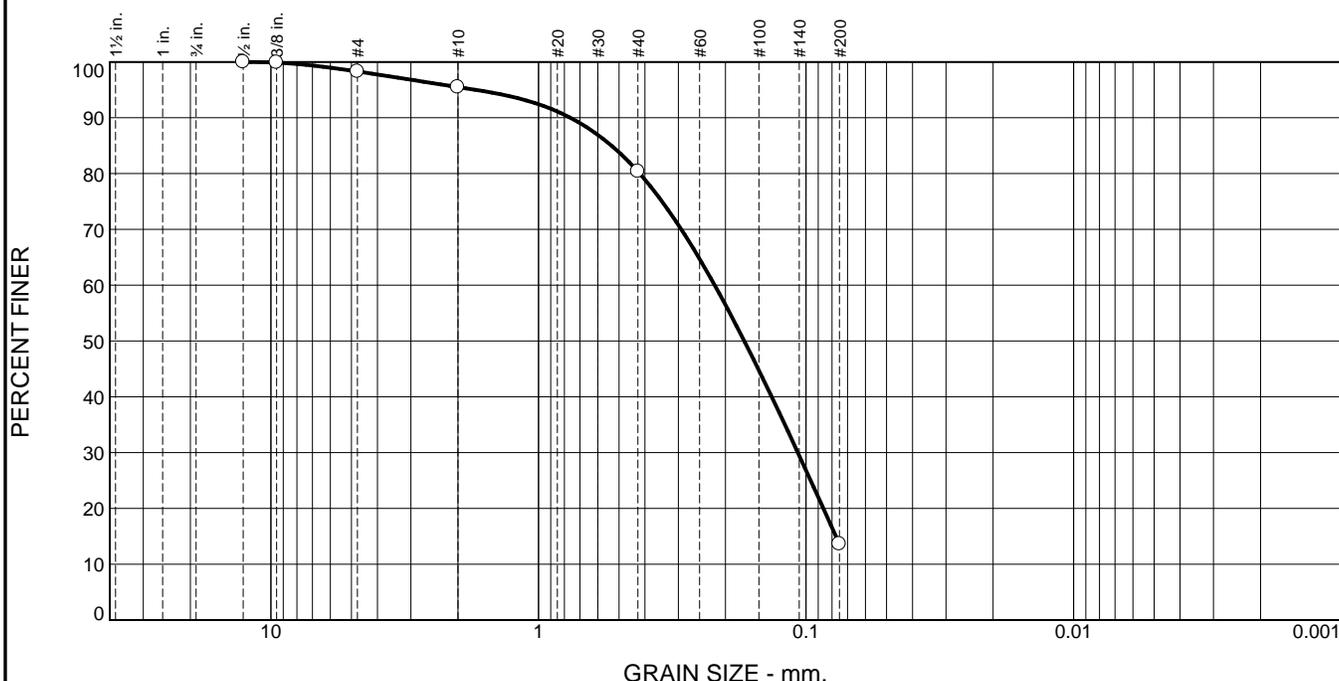
Title: Project Engineer

Source of Sample: B-7 Depth: 7.5
Sample Number: 4

Date Sampled: 6/27/2013

HILLIS-CARNES ENGINEERING ASSOCIATES DOVER, DE	Client: Becker Morgan Group Project: Assawoman Canal Trail Project No: D13064 Figure
---	--

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.7	2.8	15.1	66.8	13.6	

Test Results (ASTM D 422 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.5	100.0		
0.375	99.9		
# 4	98.3		
# 10	95.5		
# 40	80.4		
# 200	13.6		

* (no specification provided)

Material Description

Brown, fine to medium SAND, little silt

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SM AASHTO (M 145)= A-2-4(0)

Coefficients

D₉₀= 0.7599 D₈₅= 0.5331 D₆₀= 0.2195
D₅₀= 0.1702 D₃₀= 0.1073 D₁₅= 0.0773
D₁₀= C_u= C_c=

Remarks

natural moisture = 8.4%

Date Received: 6/24/2013 Date Tested: 6/25/2013

Tested By: M Frick

Checked By: J Boehm

Title: Project Engineer

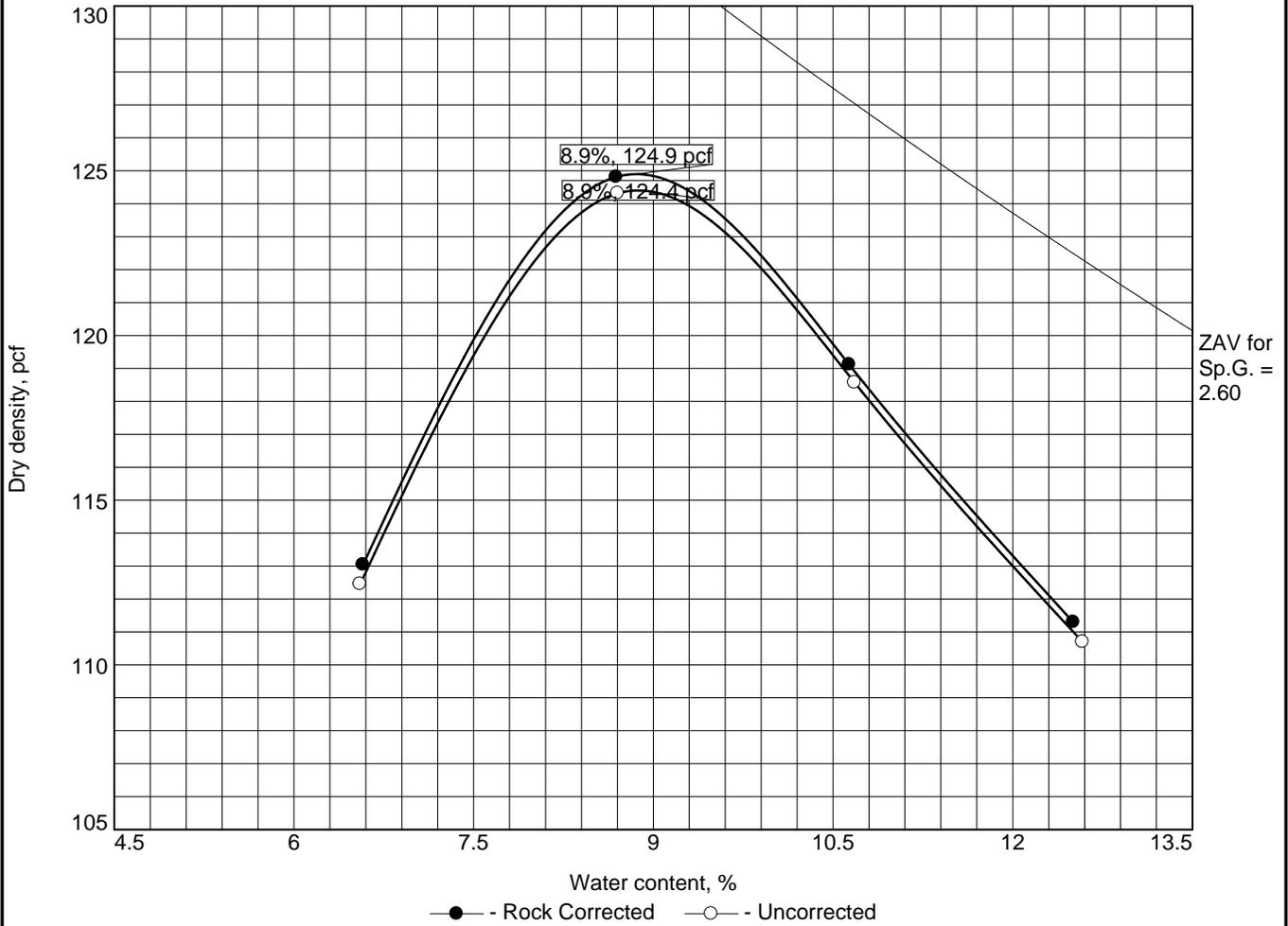
Location: Parking Lot
Sample Number: S-1

Depth: 1-3

Date Sampled: 6/24/2013

HILLIS-CARNES ENGINEERING ASSOCIATES DOVER, DE	Client: Becker Morgan Group Project: Assawoman Canal Trail Project No: D13064
Figure	

COMPACTION TEST REPORT



Test specification: ASTM D 698-07 Method A Standard
 ASTM D 4718-87 Oversize Corr. Applied to Each Test Point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
1-3	SM	A-2-4(0)	8.4	2.65	NV	NP	1.7	13.6

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 124.9 pcf	124.4 pcf	Brown, fine to medium SAND, little silt
Optimum moisture = 8.9 %	8.9 %	

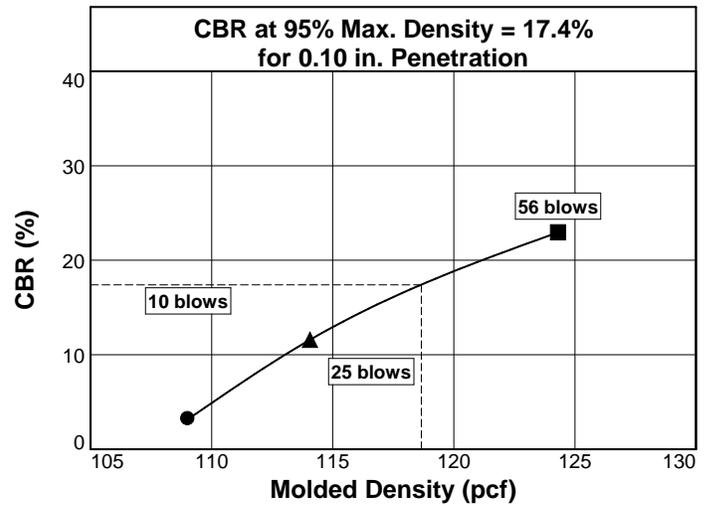
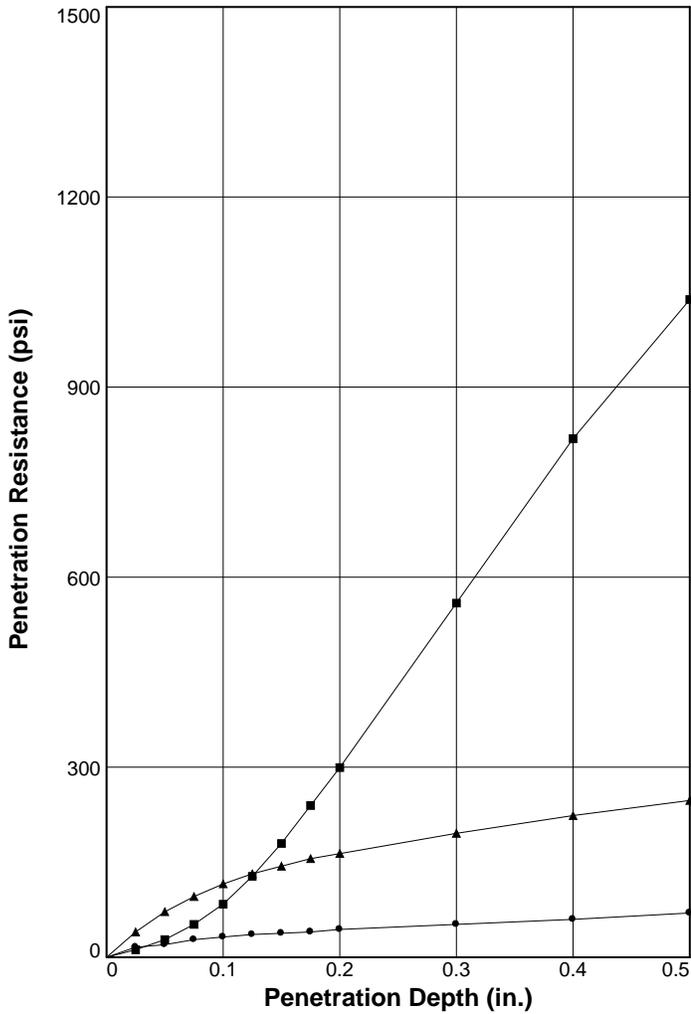
Project No. D13064 Client: Becker Morgan Group Project: Assawoman Canal Trail Location: Parking Lot Sample Number: S-1	Remarks:
HILLIS-CARNES ENGINEERING ASSOCIATES DOVER, DE	

Figure

Tested By: M Shotzberger **Checked By:** J Boehm

BEARING RATIO TEST REPORT

ASTM D 1883-07



	Molded			Soaked			CBR (%)		Linearity Correction (in.)	Surcharge (lbs.)	Max. Swell (%)
	Density (pcf)	Percent of Max. Dens.	Moisture (%)	Density (pcf)	Percent of Max. Dens.	Moisture (%)	0.10 in.	0.20 in.			
1 ○	109.0	87.3	10.0	109.0	87.3	13.6	3.2	2.9	0.000	20	0
2 △	114.1	91.4	10.1	114.1	91.3	11.6	11.6	10.9	0.000	20	0
3 □	124.3	99.5	9.9	124.3	99.5	10.0	23.0	32.2	0.071	20	0

Material Description	USCS	Max. Dens. (pcf)	Optimum Moisture (%)	LL	PI
Brown, fine to medium SAND, little silt					

Project No: D13064
Project: Assawoman Canal Trail
Location: Parking Lot
Sample Number: S-1 **Depth:** 1-3
Date: 6/24/2013

BEARING RATIO TEST REPORT

HILLIS-CARNES ENGINEERING ASSOCIATES

Test Description/Remarks:

Figure _____

HILLIS-CARNES ENGINEERING ASSOCIATES, Inc.

503 Maryland Avenue, Unit 106 • Delmar, Maryland 21875

Phone: (410)749-0940 • Fax: (410)896-7478

Description of Soils – per ASTM D2487

Major Component	Component Type	Component Description	Symbol	Group Name
Coarse-Grained Soils , More than 50% is retained on the No. 200 sieve	Gravels – More than 50% of the coarse fraction is retained on the No. 4 sieve. Coarse = 1" to 3" Medium = 1/2" to 1" Fine = 1/4" to 1/2"	Clean Gravels <5% Passing No. 200 sieve	GW	Well Graded Gravel
			GP	Poorly Graded Gravel
		Gravels with fines, >12% Passing the No. 200 sieve	GM	Silty Gravel
			GC	Clayey Gravel
	Sands – More than 50% of the coarse fraction passes the No. 4 sieve. Coarse = No.10 to No.4 Medium = No. 10 to No. 40 Fine = No. 40 to No. 200	Clean Sands <5% Passing No. 200 sieve	SW	Well Graded Sand
			SP	Poorly Graded Sand
		Sands with fines, >12% Passing the No. 200 sieve	SM	Silty Sand
			SC	Clayey Sand
Fine Grained Soils , More than 50% passes the No. 200 sieve	Silts and Clays Liquid Limit is less than 50 Low to medium plasticity	Inorganic	ML	Silt
			CL	Lean Clay
		Organic	OL	Organic silt
			OC	Organic Clay
	Silts and Clays Liquid Limit of 50 or greater Medium to high plasticity	Inorganic	MH	Elastic Silt
			CH	Fat Clay
		Organic	OH	Organic Silt
			OC	Organic Clay
Highly Organic Soils	Primarily Organic matter, dark color, organic odor		PT	Peat

Proportions of Soil Components

Component Form	Description	Approximate percent by weight
Noun	Sand, Gravel, Silt, Clay, etc.	50% or more
Adjective	Sandy, silty, clayey, etc.	35% to 49%
Some	Some sand, some silt, etc.	12% to 34%
Trace	Trace sand, trace mica, etc.	1% to 11%
With	With sand, with mica, etc.	Presence only

Particle Size Identification

Particle Size	Particle dimension
Boulder	12" diameter or more
Cobble	3" to 12" diameter
Gravel	1/4" to 3" diameter
Sand	0.005" to 1/4" diameter
Silt/Clay (fines)	Cannot see particle

Cohesive Soils

Field Description	No. of SPT Blows/ft	Consistency
Easily Molded in Hands	0 – 3	Very Soft
Easily penetrated several inches by thumb	4 – 5	Soft
Penetrated by thumb with moderate effort	6 – 10	Medium Stiff
Penetrated by thumb with great effort	11 – 30	Stiff
Indented by thumb only with great effort	Greater than 30	Hard

Granular Soils

No. of SPT Blows/ft	Relative Density
0 – 4	Very Loose
5 – 10	Loose
11 – 30	Medium Dense
31 – 50	Dense
Greater than 50	Very Dense

Other Definitions:

- **Fill:** Encountered soils that were placed by man. Fill soils may be controlled (engineered structural fill) or uncontrolled fills that may contain rubble and/or debris.
- **Saprolite:** Soil material derived from the in-place chemical and physical weathering of the parent rock material. May contain relic structure. Also called residual soils. Occurs in Piedmont soils, found west of the fall line.
- **Disintegrated Rock:** Residual soil material with rock-like properties, very dense, N = 60 to 51/0".
- **Karst:** Descriptive term which denotes the potential for solutioning of the limestone rock and the development of sinkholes.
- **Alluvium:** Recently deposited soils placed by water action, typically stream or river floodplain soils.
- **Groundwater Level:** Depth within borehole where water is encountered either during drilling, or after a set period of time to allow groundwater conditions to reach equilibrium.
- **Caved Depth:** Depth at which borehole collapsed after removal of augers/casing. Indicative of loose soils and/or groundwater conditions.

April 4, 2014

Mr. Gregory Moore, P.E.
Becker Morgan Group, Inc.
309 South Governors Avenue
Dover, Delaware 19904

1277 McD Drive
Dover, Delaware 19901
Phone 302-744-9855
Fax 302-744-9160
www.hcea.com

Reference: Report of Field Infiltration Testing for:
**Assawoman Canal Trail
Town Road Property**
Ocean View, Delaware
HCEA Project No. D14037

Dear Mr. Moore,

Hillis-Carnes Engineering Associates, Inc. (HCEA) has completed field infiltration testing at the referenced site as you requested. This letter summarizes the results of our infiltration testing. HCEA had previously performed subsurface exploration borings on the site, as described in our July 18, 2013 geotechnical report (HCEA Project No. D13065).

HCEA performed soil borings on the site on June 27, 2013. Records of soil exploration for the boring locations closest to the infiltration test locations, B-5 and B-8, are attached in the Appendix. These borings indicate a subsurface profile consisting of SAND (USCS: SP, USDA: Sand) with layers of silty SAND (USCS: SM, USDA: Loamy Sand).

We performed grain size analyses on samples obtained from the bottom of the infiltration test locations. The results are included in the appendix of this report. The soils at that depth are classified as fine to medium SAND with trace silt (SP to SP-SM) according to the Unified Soil Classification System. The USDA textural classifications are Sand.

We encountered groundwater seepage at depths between 3.5 and 4.5 feet below grade in the June 2013 borings. Based on the lack of seasonal high groundwater indicators above these depths, and the exceptionally wet spring and summer of 2013, we estimate the seasonal high groundwater level as approximately 3.5 feet below grade.

We performed single ring, falling head infiltration testing in general accordance with ASTM D 5126 at locations I-1 and I-2. Based on the results of the infiltration testing, we calculated the following hydraulic conductivities:

Test Location	Hydraulic Conductivity (in/hr)
I-1	3.50
I-2	4.75

**Town Road Property
Report of Field Infiltration Testing**

HCEA Project No. D14037

HCEA appreciates the opportunity to be of assistance to you during this phase of your project. If you have any questions regarding this report, please contact our office at (302) 744-9855.

Respectfully Submitted,
HILLIS-CARNES ENGINEERING ASSOCIATES, INC.



Jeremy M. Boehm, P.E.
Project Engineer

A handwritten signature in black ink, appearing to read "Fernando Garcia".

Fernando García
Chief Engineer

APPENDIX

Figure 1: Project Location Map

Figure 2: Boring Location Plan

Soil Borings

- 1) Records of Subsurface Investigation
- 2) Laboratory Tests Reports
- 3) Infiltration Test Results

Field Classification Sheet

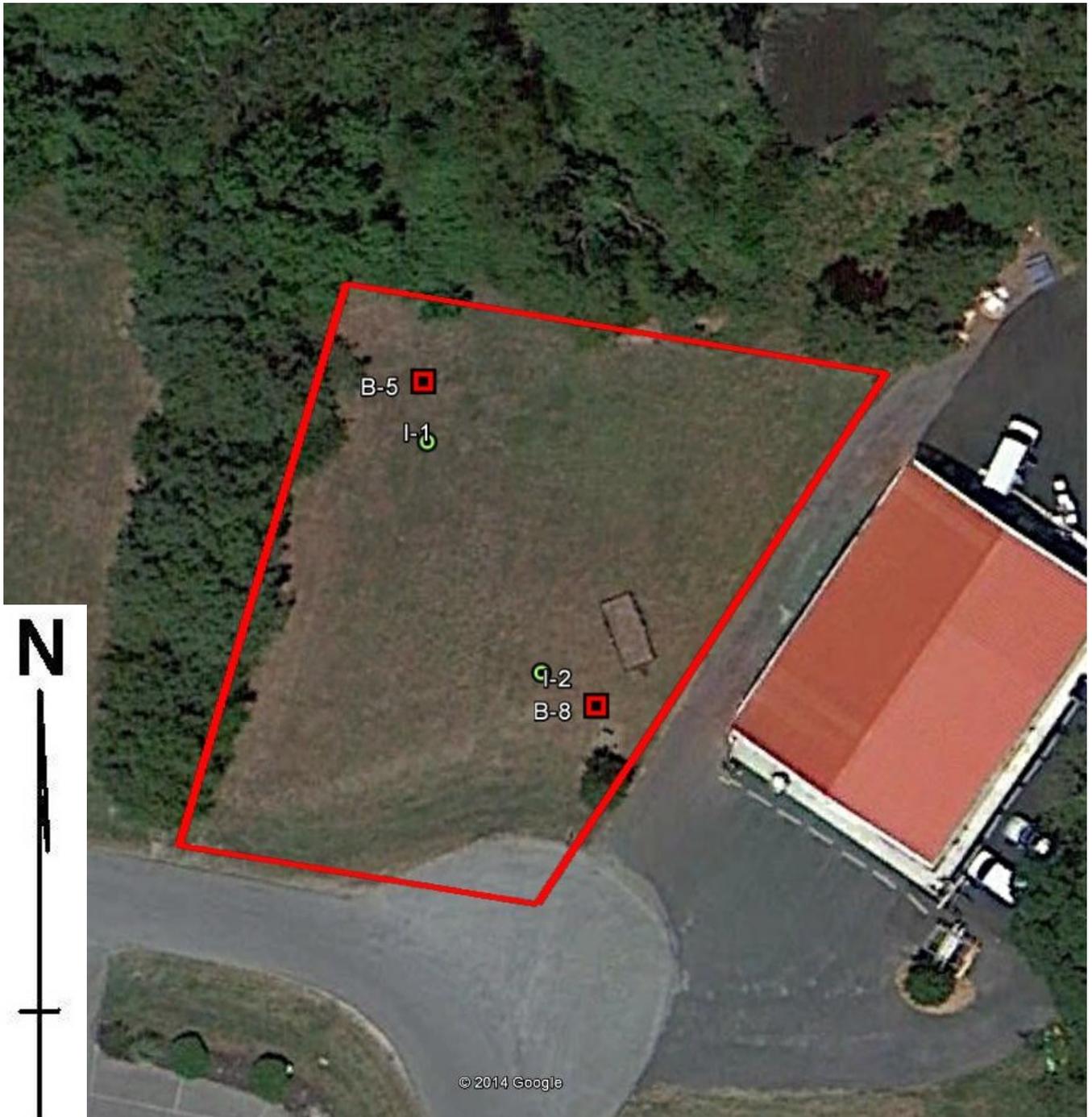


**PROJECT
SITE**

HILLIS - CARNES
ENGINEERING ASSOCIATES, INC.
 1277 McD Drive Dover, Delaware 19901
 PHONE: (302) 744-9855 FAX: (302) 744-9160

PROJECT LOCATION MAP
FIGURE 1
Town Road Property
 Ocean View, Delaware

JOB No.:	D14037	DESIGN BY:	Google
DATE:	4/4/2014	DRAWN BY:	Google
SCALE:	NTS		
PAGE:	1	CHECKED BY:	JMB



H I L L I S - C A R N E S ENGINEERING ASSOCIATES, INC. 1277 McD Drive Dover, Delaware 19901 PHONE: (302) 744-9855 FAX: (302) 744-9160	BORING LOCATION PLAN FIGURE 2 Town Road Property Ocean View, Delaware	JOB No.:	D14037	DESIGN BY:	Google
		DATE:	4/4/2014	DRAWN BY:	Google
		SCALE:	NTS		
		PAGE:	1	CHECKED BY:	JMB

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Assawoman Canal Trail
 Location Bethany Beach, DE
 Job Number D13064
 Boring Number B-5

SAMPLER

Datum _____ Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman K Hastings
 Surf. Elev. _____ ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 6/27/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 6/27/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"			No.	REC.	BORING & SAMPLING NOTES
	Brown, moist, loose, fine to coarse SAND, little silt	0		SM	▲	D	2	3	3	1	14	Approximately 10 inches of organic bearing soil (topsoil) at surface.
	Light brown, wet to saturated, medium dense, fine to coarse SAND, trace silt	4		SP	▲	D	7	11	15	2	18	
				SP	▲	D	4	8	11	3	18	
	Light brown, saturated, medium dense, fine to coarse SAND, little silt	8		SM	▲	D	2	5	6	4	18	
	Light brown, saturated, loose, fine to coarse SAND, trace silt	12		SP	▲	D	1	3	2	5	18	
	Light brown, saturated, medium dense, fine to medium SAND, trace silt	16		SP	▲	D	1	5	8	6	18	
	Boring terminated 15 feet below existing grade.	20										

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 2.75 ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Assawoman Canal Trail
 Location Bethany Beach, DE
 Job Number D13064
 Boring Number B-8

SAMPLER

Datum _____ Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman K Hastings
 Surf. Elev. _____ ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 6/27/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 6/27/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"			No.	REC.	BORING & SAMPLING NOTES
	Light brown, moist, loose, fine to medium SAND, trace silt	0		SP	▲	D	2	2	3	1	10	Approximately 12 inches of organic bearing soil (topsoil) at surface.
	Light brown, wet to saturated, medium dense, fine to coarse SAND, trace silt	4		SP	▲	D	9	13	14	2	18	
				SP	▲	D	7	13	16	3	18	
	Light brown, saturated, medium dense, fine to coarse SAND, trace silt	8		SP	▲	D	5	7	11	4	18	
				SP	▲	D	5	7	7	5	18	
		12										
		16		SP	▲	D	5	6	9	6	18	
				SP	▲	D	6	9	9	7	18	
	Boring terminated 20 feet below existing grade.	20										

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered 4 ft.
 At Completion 3.5 ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
4 ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.4	21.2	68.5	9.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
# 4	100.0		
# 10	99.6		
# 40	78.4		
# 200	9.9		

Material Description

Brown, moist, fine to medium SAND, trace silt (SP-SM)

Atterberg Limits
 PL= NP LL= NV PI= NP

Coefficients
 D₉₀= 0.7226 D₈₅= 0.5573 D₆₀= 0.2415
 D₅₀= 0.1868 D₃₀= 0.1170 D₁₅= 0.0839
 D₁₀= 0.0752 C_u= 3.21 C_c= 0.75

Classification
 USCS= SP-SM AASHTO= A-3

Remarks

* (no specification provided)

Location: Infiltration 1
Sample Number: 1 **Depth:** 2.5

Date: 4/2/2014

HILLIS-CARNES ENGINEERING ASSOCIATES

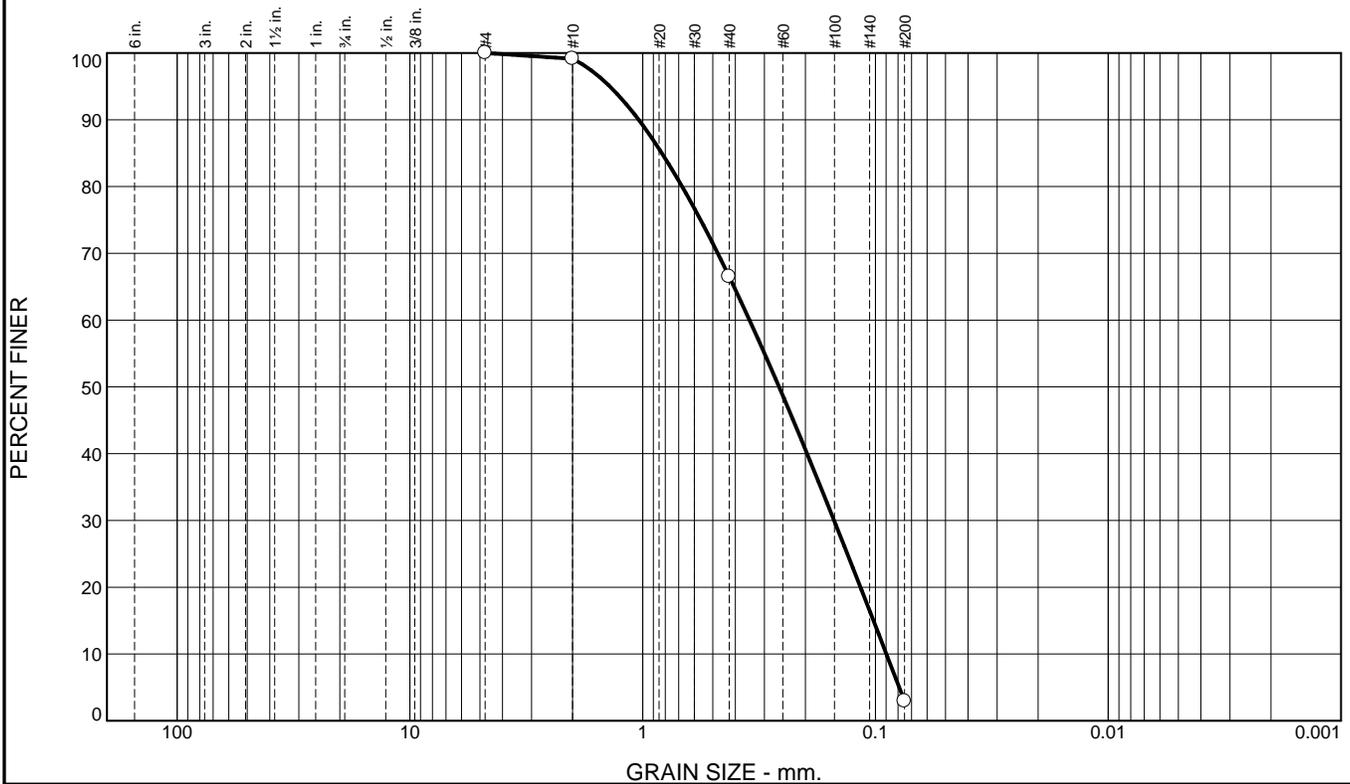
DOVER, DE

Client: Becker Morgan Group, Inc.
Project: Town Road Property Water Infiltration Testing

Project No: D14037 **Figure**

Tested By: K Kelley **Checked By:** J Boehm

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.9	32.6	63.5	3.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
# 4	100.0		
# 10	99.1		
# 40	66.5		
# 200	3.0		

Material Description

Brown, moist, fine to medium SAND, trace silt (SP)

Atterberg Limits
 PL= NP LL= NV PI= NP

Coefficients
 D₉₀= 1.0402 D₈₅= 0.8271 D₆₀= 0.3476
 D₅₀= 0.2595 D₃₀= 0.1506 D₁₅= 0.1020
 D₁₀= 0.0898 C_u= 3.87 C_c= 0.73

Classification
 USCS= SP AASHTO= A-3

Remarks

* (no specification provided)

Location: Infiltration 2
 Sample Number: 2 Depth: 2.5

Date: 4/2/2014

HILLIS-CARNES ENGINEERING ASSOCIATES DOVER, DE	Client: Becker Morgan Group, Inc. Project: Town Road Property Water Infiltration Testing Project No: D14037
--	--

Figure

Tested By: K Kelley Checked By: J Boehm

**Town Road Property
Ocean View, Delaware**

Test Depth (ft b.e.g.)	<u>IT-1</u> <u>2.5</u> Head (inch)	<u>IT-2</u> <u>2.5</u> Head (inch)
Elapsed Time (min.)		
0	30.000	30.000
5	27.000	28.000
10	25.000	24.500
15	19.500	19.500
30	13.000	13.500
45	9.000	8.500
60	1.000	0.500
60.1	30.000	30.000
75	24.000	23.000
90	20.000	18.500
105	14.000	12.500
120	9.000	8.000
135	0.250	1.000
135.1	30.000	30.000
150	23.000	22.000
165	16.000	14.000
180	11.000	10.000
195	6.000	4.000
210	1.000	1.000
210.1	30.000	30.000
225	25.000	24.000
240	18.000	15.000

D, in =	12	12
T ₁ , min =	210	210
T ₂ , min =	240	240
H ₁ , in =	30	30
H ₂ , in =	18	15

D, cm =	30.48	30.48
T ₁ , sec =	12600	12600
T ₂ , sec =	14400	14400
H ₁ , cm =	76.2	76.2
H ₂ , cm =	45.72	38.1

K = (pi * D) / (11 * (T ₂ - T ₁)) * ln (H ₁ / H ₂) =	cm/s	cm/s
	2.47E-03	3.35E-03

cm/hr	cm/hr
8.89	12.07

in/hr	in/hr
3.50	4.75

HILLIS-CARNES ENGINEERING ASSOCIATES, Inc.

1277 McD Drive • Dover, Delaware 19901

Phone: 302.744.9855 • Fax: 302.744.9160

Description of Soils – per ASTM D2487

Major Component	Component Type	Component Description	Symbol	Group Name
Coarse-Grained Soils , More than 50% is retained on the No. 200 sieve	Gravels – More than 50% of the coarse fraction is retained on the No. 4 sieve. Coarse = 1" to 3" Medium = ½" to 1" Fine = ¼" to ½"	Clean Gravels <5% Passing No. 200 sieve	GW	Well Graded Gravel
			GP	Poorly Graded Gravel
		Gravels with fines, >12% Passing the No. 200 sieve	GM	Silty Gravel
	Sands – More than 50% of the coarse fraction passes the No. 4 sieve. Coarse = No.10 to No.4 Medium = No. 10 to No. 40 Fine = No. 40 to No. 200	Clean Sands <5% Passing No. 200 sieve	SW	Well Graded Sand
			SP	Poorly Graded Sand
		Sands with fines, >12% Passing the No. 200 sieve	SM	Silty Sand
Fine Grained Soils , More than 50% passes the No. 200 sieve	Silts and Clays Liquid Limit is less than 50 Low to medium plasticity	Inorganic	ML	Silt
			CL	Lean Clay
		Organic	OL	Organic silt Organic Clay
	Silts and Clays Liquid Limit of 50 or greater Medium to high plasticity	Inorganic	MH	Elastic Silt
			CH	Fat Clay
		Organic	OH	Organic Silt Organic Clay
Highly Organic Soils	Primarily Organic matter, dark color, organic odor		PT	Peat

Proportions of Soil Components

Component Form	Description	Approximate percent by weight
Noun	Sand, Gravel, Silt, Clay, etc.	50% or more
Adjective	Sandy, silty, clayey, etc.	35% to 49%
Some	Some sand, some silt, etc.	12% to 34%
Trace	Trace sand, trace mica, etc.	1% to 11%
With	With sand, with mica, etc.	Presence only

Particle Size Identification

Particle Size	Particle dimension
Boulder	12" diameter or more
Cobble	3" to 12" diameter
Gravel	¼" to 3" diameter
Sand	0.005" to ¼" diameter
Silt/Clay (fines)	Cannot see particle

Cohesive Soils

Field Description	No. of SPT Blows/ft	Consistency
Easily Molded in Hands	0 – 3	Very Soft
Easily penetrated several inches by thumb	4 – 5	Soft
Penetrated by thumb with moderate effort	6 – 10	Medium
Penetrated by thumb with great effort	11 – 30	Stiff
Indented by thumb only with great effort	Greater than 30	Hard

Granular Soils

No. of SPT Blows/ft	Relative Density
0 – 4	Very Loose
5 – 10	Loose
11 – 30	Medium Dense
31 – 50	Dense
Greater than 50	Very Dense

Other Definitions:

- **Fill:** Encountered soils that were placed by man. Fill soils may be controlled (engineered structural fill) or uncontrolled fills that may contain rubble and/or debris.
- **Saprolite:** Soil material derived from the in-place chemical and physical weathering of the parent rock material. May contain relic structure. Also called residual soils. Occurs in Piedmont soils, found west of the fall line.
- **Disintegrated Rock:** Residual soil material with rock-like properties, very dense, N = 60 to 51/0".
- **Karst:** Descriptive term which denotes the potential for solutioning of the limestone rock and the development of sinkholes.
- **Alluvium:** Recently deposited soils placed by water action, typically stream or river floodplain soils.
- **Groundwater Level:** Depth within borehole where water is encountered either during drilling, or after a set period of time to allow groundwater conditions to reach equilibrium.
- **Caved Depth:** Depth at which borehole collapsed after removal of augers/casing. Indicative of loose soils and/or groundwater conditions.

HILLIS-CARNES ENGINEERING ASSOCIATES, INC.

July 10, 2014

Mr. Dean Holden
Becker Morgan Group
309 South Governors Avenue
Dover, Delaware 19904

1277 McD Drive
Dover, Delaware 19901
Phone 302-744-9855
Fax 302-744-9160
www.hcea.com

Reference: **Pervious Pavement**
Assawoman Canal Trail
Ocean View, Delaware
HCEA Project No. D13064

Dear Mr. Holden:

In pursuance of our agreement, Hillis-Carnes Engineering Associates, Inc. (HCEA) has prepared recommendations for the design and construction of base section for pervious pavement. The base section will consist of washed aggregate and geotextiles, and will support Pavedrain concrete pavers.

We understand that the pervious pavement section will need approximately 12 inches of washed aggregate (AASHTO #2 or #57) for stormwater storage capacity. We understand that DNREC requires any separation geotextile be nonwoven, needle punched polypropylene with water flow rate (ASTM D4491) of at least 125 gal/min/sf and an apparent opening size equivalent to US #70 or #80 sieve.

A review of the Pavedrain literature indicates that a reinforcing geotextile (geogrid) is strongly recommended. We note that the examples provided in the Pavedrain literature do not satisfy the project requirements for water flow rate. HCEA has therefore decided to employ two geosynthetics in the design, a nonwoven separation geotextile satisfying the permittivity requirements and a biaxial (or triaxial) geogrid for structural reinforcement.

We recommend the following pavement section:

Layer	Thickness
Pavedrain pavers	-
#57 crushed stone	6 inches
geogrid (described below)	-
# 2 crushed stone	6* inches
separation geotextile (described below)	-
native subgrade	n/a

If additional crushed stone is needed for water storage the thickness of the #2 stone layer may be increased.

The geogrid reinforcement should be placed at the top of the #2 stone (directly below the #57 stone) and should be a biaxial geogrid with a minimum strength at 5% elongation of 700 lb/ft or greater in both directions. Examples include Miragrid 3XT by TenCate Geosynthetics and BX130060 by Tensar. Alternately a triaxial geogrid such as Tensar TX130 can be used.

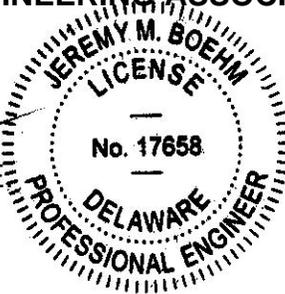
The separation geotextile should be a nonwoven, punched, polypropylene material selected to satisfy DNREC requirements. Examples include Geotex 401 by Propex Geotextile Systems and Mirafi 140N by TenCate Geosynthetics.

HCEA appreciates the opportunity to be of assistance to you during this phase of your project. If you have any questions regarding this report, please contact our office at (302) 744-9855.

Respectfully,

HILLIS-CARNES ENGINEERING ASSOCIATES, INC.


Jeremy M. Boehm, P.E.
Project Engineer




Fernando Garcia, P.E.
Chief Engineer



Dean E. Holden

From: Jeremy Boehm <jboehm@hcea.com>
Sent: Friday, July 11, 2014 2:10 PM
To: Dean E. Holden
Cc: Jonathan S. Falkowski
Subject: RE: Assawoman Pervious Pavement

Dean,

Based on the detail, we can reduce the thickness of the #57 stone to 4 inches. The #2 stone should be increased to 8 inches to keep the total thickness at 12.

Jeremy Boehm, P.E. | Project Engineer
HILLIS-CARNES ENGINEERING ASSOCIATES

Cell 302-382-2748
Phone 302-744-9855 ext 103
Fax 1-302-744-9160

From: Dean E. Holden [<mailto:dholden@beckermorgan.com>]
Sent: Friday, July 11, 2014 1:55 PM
To: Jeremy Boehm
Cc: Jonathan S. Falkowski
Subject: RE: Assawoman Pervious Pavement

Thanks Jeremy,
See attached section as discussed. It shows 4" of 57 over 8" of #2.
Dean

Dean E. Holden, P.E.
Becker Morgan Group, Inc.
302.734.7950 | 302.734.7965 fax
www.beckermorgan.com

From: Jeremy Boehm [<mailto:jboehm@hcea.com>]
Sent: Friday, July 11, 2014 1:38 PM
To: Dean E. Holden
Subject: Assawoman Pervious Pavement

Dean,

Here is the pervious pavement recommendation for the Assawoman Canal Trail project.

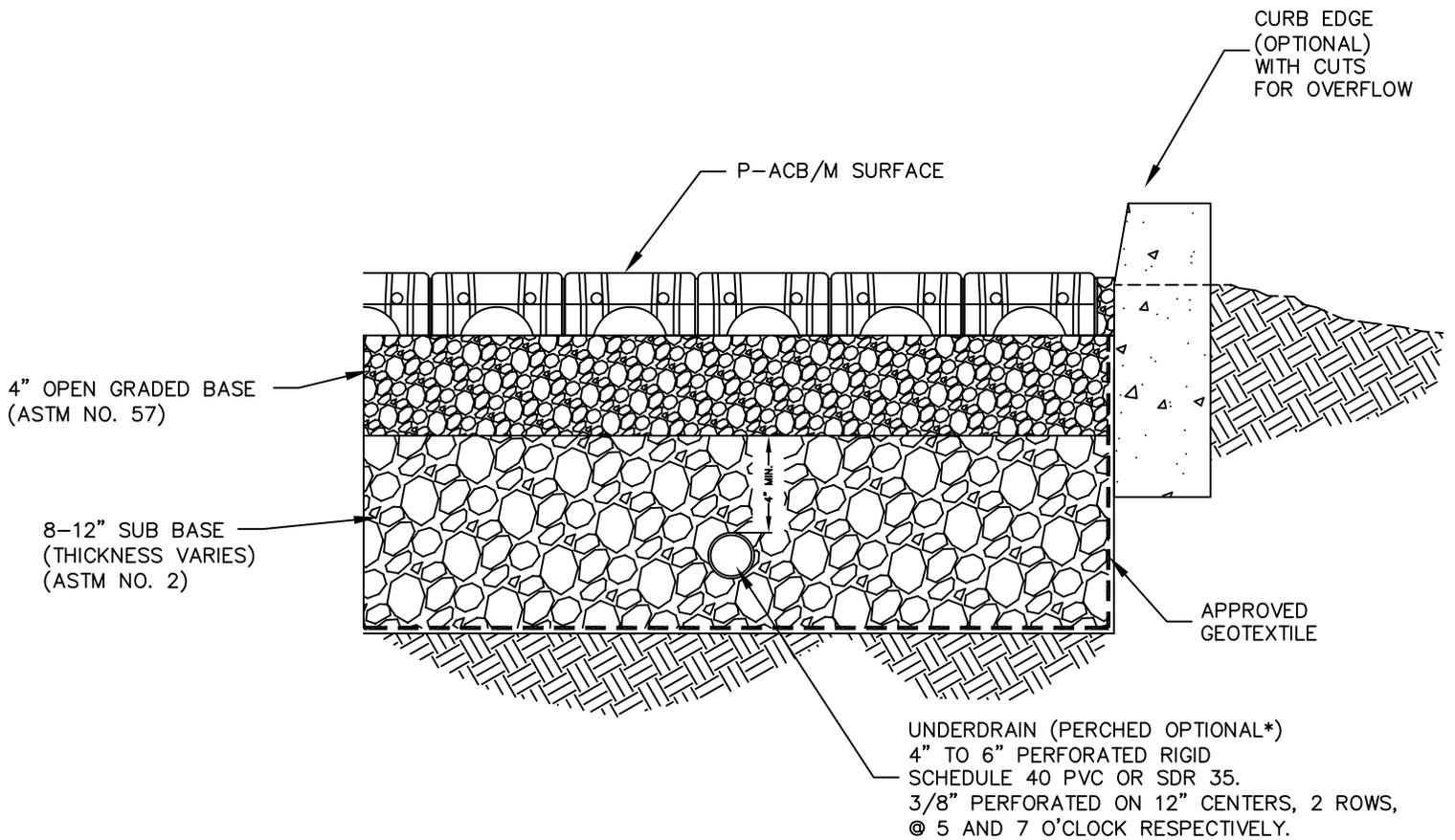
Jeremy Boehm, P.E. | Project Engineer
HILLIS-CARNES ENGINEERING ASSOCIATES

1277 McD Drive
Dover, DE 19901
Cell 302-382-2748
Phone 302-744-9855 ext 103
Fax 1-302-744-9160
Email jboehm@hcea.com
Website www.hcea.com

LinkedIn 



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PERMEABLE – ARTICULATING CONCRETE BLOCK/MAT
TYPICAL SECTION

* THE NEED FOR A PERCHED UNDERDRAIN IS OPTIONAL AND IS DEPENDENT ON THE INFILTRATION RATE OF THE SUBGRADE SOIL. PLASTIC SOILS SHOULD NOT PERCH THE UNDERDRAIN. THE HORIZONTAL AND VERTICAL LOCATION OF ALL UNDERDRAINS SHALL BE DETERMINED BY THE ENGINEER, AND SHOWN ON THE PLANS.

* ADDITIONAL UNDERDRAINS MAY BE PERCHED ABOVE THE REQUIRED STORAGE ELEVATION AND WITHIN THE STORAGE BED IN ORDER TO PROTECT THE PAVER BLOCKS FROM UPFLOWS RESULTING FROM SURCHARGE.

PAVEDRAIN
 STANDARD DETAIL

CROSS-SECTION
 SCALE: N.T.S.



PH: (888) 575-5339
 WWW.PAVEDRAIN.COM
 Email: info@pavedrain.com

June 25, 2014

Mr. Dean Holden
Becker Morgan Group
Port Exchange
312 W. Main Street
Salisbury, Maryland 21801

1277 McD Drive
Dover, Delaware 19901
Phone 302-744-9855
Fax 302-744-9160
www.hcea.com

Reference: **Pedestrian Bridge Helical Piles**
Assawoman Canal Trail
Ocean View, Delaware
HCEA Project No. D13064

Dear Mr. Holden:

In pursuance of our agreement, Hillis-Carnes Engineering Associates, Inc. (HCEA) has prepared recommendations for the design and construction of helical piles to support the proposed pedestrian bridge for the Assawoman Canal Trail. HCEA has based the recommendations in this letter in the HCEA Geotechnical Engineering Study dated July 18, 2013. This letter should be considered an addendum to that report. The boring location plan and logs of the three closest test borings (B-1, B-2, and B-3) are attached to this letter.

Based on the information supplied by Becker Morgan Group and the preliminary structural drawings by E.T. Techtonics, the structure will consist of fiberglass trusses with a wood deck. The weight of the structure will be approximately 12 kips, with an estimated live load of 10 kips (emergency vehicle). The bridge deck will be approximately 10 feet wide and 60 feet long.

Helical piles consist of one to six bearing plates (typically two or three) attached to a central shaft. The piles are installed by rotation, similar to a screw. A torque meter is used to determine when the piles have reached design capacity. Helical piles are proprietary systems available from multiple manufacturers, but sharing common characteristics. HCEA should review the pile capacities and installation procedures submitted by the helical pile contractor. The following table provides the allowable vertical (compression and tension) capacity based on widely available configurations and a factor of safety of 2.5.

Total Length*	Plate 1 Diameter	Plate 2 Diameter	Plate 3 Diameter	Allowable Axial Load	Installation Torque
11 ft.	8 in.	10 in.	-	5 kips	1300 ft-lb
11 ft.	10 in.	12 in.	-	7.5 kips	1950 ft-lb
13 ft.	8 in.	10 in.	12 in.	11 kips	2850 ft-lb

*Total Length from ground surface to lowest plate for vertically oriented piles. Battered piles will be longer in proportion to the batter.

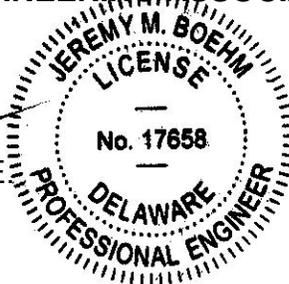
Helical piles should extend a minimum of 8 feet below grade in order to penetrate into the intended bearing layer. Piles should be spaced at a minimum separation horizontal separation in the bearing layer equal to five times the diameter of the largest plate. The values given in the table are based on an effective angle of internal friction of 31 degrees and an buoyant unit weight of 58 pound per cubic foot for the medium dense sand. Installation torques are based on a helix torque factor (K_t) of 10 ft^{-1} . The required installation torque should be adjusted for the K_t of the selected pile shaft. The selected pile shaft should be checked for allowable axial and torsional capacity.

HCEA appreciates the opportunity to be of assistance to you during this phase of your project. If you have any questions regarding this report, please contact our office at (302) 744-9855.

Respectfully,

HILLIS-CARNES ENGINEERING ASSOCIATES, INC.

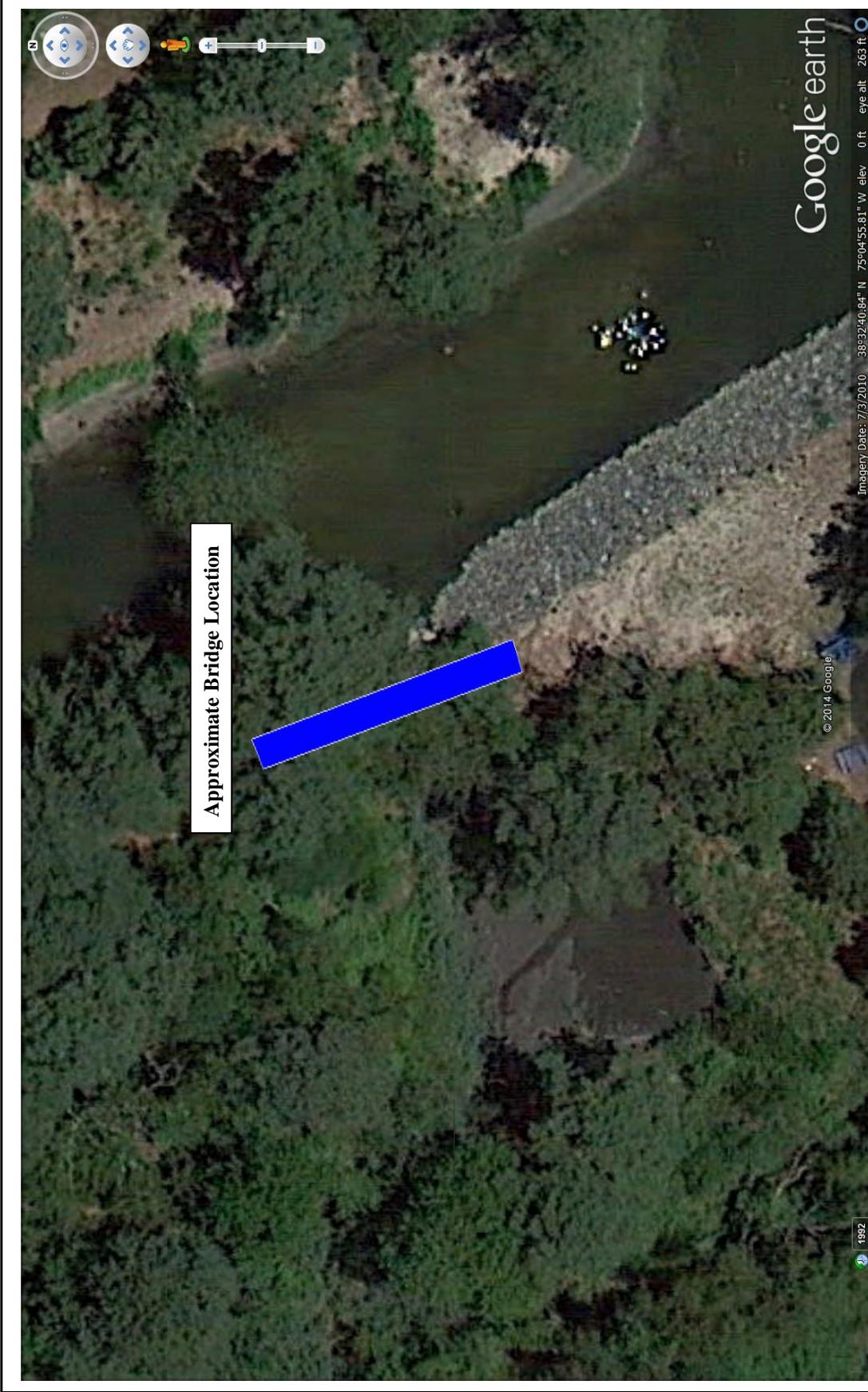

Jeremy M. Boehm, P.E.
Project Engineer




Fernando Garcia, P.E.
Chief Engineer



HILLIS-CARNES ENGINEERING ASSOCIATES, INC.



Approximate Bridge Location

HILLIS - CARNES		Project Location Map		JOB No: D13064	DESIGN BY: Google
ENGINEERING ASSOCIATES, INC.		FIGURE 1		DATE: 6/23/2014	DRAWN BY: Google
1277 McD Drive Dover, DE 19901		Assawoman Canal Trail Pedestrian Bridge		SCALE: as shown	
PHONE: (302) 744-9855		Ocean View, Delaware		PAGE: 1	CHECKED BY: JMB
FAX: (302) 744-9160					

HILLIS-CARNES ENGINEERING ASSOCIATES, INC.



HILLIS - CARNES ENGINEERING ASSOCIATES, INC. 1277 McD Drive Dover, DE 19901 PHONE: (302) 744-9855 FAX: (302) 744-9160	Test Location Plan FIGURE 2 Assawoman Canal Trail Pedestrian Bridge Ocean View, Delaware			JOB No: D13064 DESIGN BY: Google
	DATE: 6/23/2014 SCALE: as shown PAGE: 1		DRAWN BY: Google CHECKED BY: JMB	

HILLIS-CARNES ENGINEERING ASSOCIATES, INC.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Assawoman Canal Trail
 Location Bethany Beach, DE
 Job Number D13064
 Boring Number B-1

SAMPLER

Datum _____ Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman K Hastings
 Surf. Elev. _____ ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 6/27/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 6/27/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"			No.	REC.	BORING & SAMPLING NOTES
	Light brown, dry, very loose, fine to coarse SAND, trace silt, trace fine gravel	0		SP	▲	D	1	2	2	1	14	
	Dark Brown, wet, loose, fine to medium SAND, little organic silt			SM	▲	D	2	2	3	2	18	
	Light brown, saturated, medium dense, fine to medium SAND, little silt	5		SM	▲	D	5	13	15	3	18	
	Light brown, saturated, medium dense, fine to coarse SAND, trace silt, trace fine gravel			SP	▲	D	5	7	13	4	18	
		10		SP	▲	D	4	5	11	5	18	
		15		SP	▲	D	5	7	7	6	18	
	Light brown, saturated, medium dense, fine to medium SAND < trace silt	20		SP	▲	D	4	7	6	7	18	
	Light brown and gray, saturated, very loose, fine to medium SAND, little silt	25		SM	▲	D	4	2	2	8	18	

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered 5 ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
4 ft.
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Assawoman Canal Trail
 Location Bethany Beach, DE
 Job Number D13064
 Boring Number B-1

SAMPLER

Datum _____ Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman K Hastings
 Surf. Elev. _____ ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 6/27/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 6/27/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"			No.	REC.	BORING & SAMPLING NOTES
		30		CH	▲	D	2	3	2	9	18	
	Dark brown, saturated, soft to medium, silty CLAY, trace organic silt			CH	▲	D	2	3	3	10	18	
	Boring terminated 35 feet below existing grade.	35										
		40										
		45										
		50										
		55										

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered 5 ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Assawoman Canal Trail
 Location Bethany Beach, DE
 Job Number D13064
 Boring Number B-2

SAMPLER

Datum _____ Hammer Wt. _____ lb. Hole Diameter 4 in. Foreman K Hastings
 Surf. Elev. _____ ft. Hammer Drop _____ in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 6/28/2013 Sampler Diameter _____ in. O.D. Boring Method HA Date Completed 6/28/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLER TYPE	CON	SAMPLE Blows per 6"	No.	REC.	BORING & SAMPLING NOTES
	Brown, dry, fine to medium SAND, little silt	0		SM		D		1		
	Light brown, dry, fine to coarse SAND, trace silt			SP		D		2		
		2.5								
	Brown, moist, fine to medium SAND, trace silt			SP		D		3		
		5								
	Gray, saturated, fine to medium SAND, little organic SILT			SM		D		4		
	Boring terminated 7 feet below existing grade.	7.5								
		10								
		12.5								

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Assawoman Canal Trail
 Location Bethany Beach, DE
 Job Number D13064
 Boring Number B-3

SAMPLER

Datum _____ Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman K Hastings
 Surf. Elev. _____ ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 6/28/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 6/28/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"			No.	REC.	BORING & SAMPLING NOTES
0	Brown, moist, loose, fine to medium SAND, little silt	0		SM	▲	D	3	3	4	1	16	Approximately 12 inches of organic bearing soil (topsoil) at surface.
	Gray, wet to saturated, dense to medium dense, fine to medium SAND, trace silt			SP	▲	D	10	15	16	2	18	
5				SP	▲	D	6	13	16	3	18	
	Light brown, saturated, medium dense, fine to coarse SAND, trace silt			SP	▲	D	6	8	9	4	18	
10				SP	▲	D	3	5	11	5	18	
	Light brown, saturated, dense, fine to medium SAND, trace silt			SP	▲	D	6	12	20	6	18	
15				SP	▲	D	7	13	18	7	18	
20	Boring terminated 20 feet below existing grade.	20										
25		25										

SAMPLER TYPE DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED PT - PRESSED SHELBY TUBE CA - CONTINUOUS FLIGHT AUGER RC - ROCK CORE	SAMPLE CONDITIONS D - DISINTEGRATED I - INTACT U - UNDISTURBED L - LOST	GROUND WATER Encountered <u>3.5</u> ft. At Completion <u>3.5</u> ft. After Auger Removal _____ ft. Backfilled _____ ft.	CAVE IN DEPTH <u>3.75</u> ft. _____ _____	BORING METHOD HSA - HOLLOW STEM AUGERS CFA - CONTINUOUS FLIGHT AUGERS DC - DRIVING CASING MD - MUD DRILLING
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STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

HILLIS-CARNES ENGINEERING ASSOCIATES, Inc.

1277 McD Drive • Dover, Delaware 19901

Phone: 302.744.9855 • Fax: 302.744.9160

Description of Soils – per ASTM D2487

Major Component	Component Type	Component Description	Symbol	Group Name
Coarse-Grained Soils , More than 50% is retained on the No. 200 sieve	Gravels – More than 50% of the coarse fraction is retained on the No. 4 sieve. Coarse = 1" to 3" Medium = ½" to 1" Fine = ¼" to ½"	Clean Gravels <5% Passing No. 200 sieve	GW	Well Graded Gravel
			GP	Poorly Graded Gravel
		Gravels with fines, >12% Passing the No. 200 sieve	GM	Silty Gravel
	Sands – More than 50% of the coarse fraction passes the No. 4 sieve. Coarse = No.10 to No.4 Medium = No. 10 to No. 40 Fine = No. 40 to No. 200	Clean Sands <5% Passing No. 200 sieve	SW	Well Graded Sand
			SP	Poorly Graded Sand
		Sands with fines, >12% Passing the No. 200 sieve	SM	Silty Sand
Fine Grained Soils , More than 50% passes the No. 200 sieve	Silts and Clays Liquid Limit is less than 50 Low to medium plasticity	Inorganic	ML	Silt
			CL	Lean Clay
		Organic	OL	Organic silt Organic Clay
	Silts and Clays Liquid Limit of 50 or greater Medium to high plasticity	Inorganic	MH	Elastic Silt
			CH	Fat Clay
		Organic	OH	Organic Silt Organic Clay
Highly Organic Soils	Primarily Organic matter, dark color, organic odor		PT	Peat

Proportions of Soil Components

Component Form	Description	Approximate percent by weight
Noun	Sand, Gravel, Silt, Clay, etc.	50% or more
Adjective	Sandy, silty, clayey, etc.	35% to 49%
Some	Some sand, some silt, etc.	12% to 34%
Trace	Trace sand, trace mica, etc.	1% to 11%
With	With sand, with mica, etc.	Presence only

Particle Size Identification

Particle Size	Particle dimension
Boulder	12" diameter or more
Cobble	3" to 12" diameter
Gravel	¼" to 3" diameter
Sand	0.005" to ¼" diameter
Silt/Clay (fines)	Cannot see particle

Cohesive Soils

Field Description	No. of SPT Blows/ft	Consistency
Easily Molded in Hands	0 – 3	Very Soft
Easily penetrated several inches by thumb	4 – 5	Soft
Penetrated by thumb with moderate effort	6 – 10	Medium
Penetrated by thumb with great effort	11 – 30	Stiff
Indented by thumb only with great effort	Greater than 30	Hard

Granular Soils

No. of SPT Blows/ft	Relative Density
0 – 4	Very Loose
5 – 10	Loose
11 – 30	Medium Dense
31 – 50	Dense
Greater than 50	Very Dense

Other Definitions:

- **Fill:** Encountered soils that were placed by man. Fill soils may be controlled (engineered structural fill) or uncontrolled fills that may contain rubble and/or debris.
- **Saprolite:** Soil material derived from the in-place chemical and physical weathering of the parent rock material. May contain relic structure. Also called residual soils. Occurs in Piedmont soils, found west of the fall line.
- **Disintegrated Rock:** Residual soil material with rock-like properties, very dense, N = 60 to 51/0".
- **Karst:** Descriptive term which denotes the potential for solutioning of the limestone rock and the development of sinkholes.
- **Alluvium:** Recently deposited soils placed by water action, typically stream or river floodplain soils.
- **Groundwater Level:** Depth within borehole where water is encountered either during drilling, or after a set period of time to allow groundwater conditions to reach equilibrium.
- **Caved Depth:** Depth at which borehole collapsed after removal of augers/casing. Indicative of loose soils and/or groundwater conditions.

HILLIS-CARNES ENGINEERING ASSOCIATES, INC.