BOWIE STATE UNIVERSITY
CAR PARKING LOT

TECHNICAL SPECIFICATIONS

100% CD SUBMISSION

NOVEMBER 2, 2018

Prepared by

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## Table of Contents

<table>
<thead>
<tr>
<th>Division</th>
<th>Section Title</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SPECIFICATIONS GROUP</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>DIVISION 01 - GENERAL REQUIREMENTS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>011000</td>
<td>SUMMARY</td>
<td>7</td>
</tr>
<tr>
<td>012100</td>
<td>ALLOWANCES</td>
<td>2</td>
</tr>
<tr>
<td>012200</td>
<td>UNIT PRICES</td>
<td>2</td>
</tr>
<tr>
<td>012300</td>
<td>ALTERNATES</td>
<td>3</td>
</tr>
<tr>
<td>012500</td>
<td>SUBSTITUTION PROCEDURES</td>
<td>5</td>
</tr>
<tr>
<td>012600</td>
<td>CONTRACT MODIFICATION PROCEDURES</td>
<td>4</td>
</tr>
<tr>
<td>012900</td>
<td>PAYMENT PROCEDURES</td>
<td>8</td>
</tr>
<tr>
<td>013100</td>
<td>PROJECT MANAGEMENT AND COORDINATION</td>
<td>20</td>
</tr>
<tr>
<td>013200</td>
<td>CONSTRUCTION PROGRESS DOCUMENTATION</td>
<td>13</td>
</tr>
<tr>
<td>013233</td>
<td></td>
<td></td>
</tr>
<tr>
<td>013300</td>
<td>PHOTOGRAPHIC DOCUMENTATION</td>
<td>2</td>
</tr>
<tr>
<td>013300</td>
<td>SUBMITTAL PROCEDURES</td>
<td>14</td>
</tr>
<tr>
<td>014000</td>
<td>QUALITY REQUIREMENTS</td>
<td>15</td>
</tr>
<tr>
<td>015000</td>
<td>TEMPORARY FACILITIES AND CONTROLS</td>
<td>17</td>
</tr>
<tr>
<td>017300</td>
<td>EXECUTION</td>
<td>14</td>
</tr>
<tr>
<td>017700</td>
<td>CLOSEOUT PROCEDURES</td>
<td>9</td>
</tr>
<tr>
<td>017823</td>
<td>OPERATION AND MAINTENANCE DATA</td>
<td>10</td>
</tr>
<tr>
<td><strong>DIVISION 02 - EXISTING CONDITIONS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>024116</td>
<td>STRUCTURE DEMOLITION</td>
<td>12</td>
</tr>
<tr>
<td><strong>DIVISION 02 - EXISTING CONDITIONS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>033000</td>
<td>CAST-IN-PLACE CONCRETE</td>
<td>20</td>
</tr>
<tr>
<td><strong>DIVISION 26 - ELECTRICAL</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>260010</td>
<td>ELECTRICAL GENERAL PROVISIONS</td>
<td>5</td>
</tr>
<tr>
<td>260051</td>
<td>COMMON WORK RESULTS FOR ELECTRICAL</td>
<td>5</td>
</tr>
<tr>
<td>260060</td>
<td>GROUNDING AND BONDING</td>
<td>3</td>
</tr>
<tr>
<td>260073</td>
<td>HANGERS AND SUPPORTS FOR ELECTRICAL</td>
<td>5</td>
</tr>
<tr>
<td>260075</td>
<td>SYSTEMS ELECTRICAL IDENTIFICATION</td>
<td>4</td>
</tr>
<tr>
<td>260119</td>
<td>UNDERGROUND DUCTS AND UTILITY</td>
<td>10</td>
</tr>
<tr>
<td>260120</td>
<td>STRUCTURES CONDUCTORS AND CABLES</td>
<td>5</td>
</tr>
<tr>
<td>260130</td>
<td>RACEWAY AND BOXES</td>
<td>6</td>
</tr>
<tr>
<td>260410</td>
<td>ENCLOSED SWITCHES AND CIRCUIT BREAKERS</td>
<td>5</td>
</tr>
<tr>
<td>265600</td>
<td>EXTERIOR LIGHTING</td>
<td>9</td>
</tr>
<tr>
<td><strong>DIVISION 31 - EARTHWORK</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>311000</td>
<td>SITE CLEARING</td>
<td>10</td>
</tr>
<tr>
<td>312000</td>
<td>EARTH MOVING</td>
<td>26</td>
</tr>
<tr>
<td><strong>DIVISION 32 - EXTERIOR IMPROVEMENTS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>321216</td>
<td>ASPHALT PAVING</td>
<td>16</td>
</tr>
<tr>
<td>321313</td>
<td>CONCRETE PAVING</td>
<td>26</td>
</tr>
<tr>
<td>321373</td>
<td>CONCRETE PAVING JOINT SEALANTS</td>
<td>8</td>
</tr>
</tbody>
</table>

TABLE OF CONTENTS

TOC - 1
### Bowie State University - Car Parking Lot

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>321400</td>
<td>UNIT PAVING</td>
<td>6</td>
</tr>
<tr>
<td>321713</td>
<td>PARKING BUMPERS</td>
<td>4</td>
</tr>
<tr>
<td>321723</td>
<td>PAVEMENT MARKINGS</td>
<td>5</td>
</tr>
<tr>
<td>321726</td>
<td>TACTILE WARNING SURFACING</td>
<td>14</td>
</tr>
<tr>
<td>329115</td>
<td>SOIL PREPARATION (PERFORMANCE SPECIFICATION)</td>
<td>7</td>
</tr>
<tr>
<td>329200</td>
<td>TURF AND GRASSES</td>
<td>22</td>
</tr>
<tr>
<td>329300</td>
<td>PLANTS</td>
<td>31</td>
</tr>
</tbody>
</table>

### DIVISION 33 - UTILITIES

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>334800</td>
<td>STORMWATER MANAGEMENT</td>
<td>2</td>
</tr>
<tr>
<td>334200</td>
<td>STORMWATER CONVEYANCE</td>
<td>40</td>
</tr>
</tbody>
</table>

END OF TABLE OF CONTENTS
SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Work by Owner.
4. Access to site.
5. Coordination with occupants.
6. Work restrictions.
7. Specification and Drawing conventions.
8. Miscellaneous provisions.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

A. Project Identification: Bowie State University Car Parking Lot.

1. Project Location: Bowie State University, 14000 Jericho Park Road, Bowie, Maryland 20715

B. Owner: Bowie State University.

1. Owner's Representative: Michael Harris, Project Manager

C. ENGINEER: Whitney, Bailey, Cox and Magnani, LLC.

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

1. Electrical Engineer: Min Engineering, Inc
2. Geotechnical Engineer: Findling, Inc
1.4 WORK COVERED BY CONTRACT DOCUMENTS

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

1. The project consists of the construction of a new surface parking lot located off the existing campus loop road. The project includes, but is not limited to, the following work; site demolition, clearing, grading, paving, curb & gutter, sidewalks, site lightings, storm drains, stormwater management facilities, landscaping and other Work indicated in the Contract Documents.

B. Type of Contract:

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

1.5 WORK BY OWNER

A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.

B. Concurrent Work: Owner will perform the following construction operations at Project site. Those operations will be conducted simultaneously with Work under this Contract.

1. The Owner is planning the installation of a solar array covering portion(s) of the parking lot to be constructed under this contract. Solar array foundations and power / cabling to and from the arrays are anticipated within the project area. Caisson foundations for solar arrays are anticipated to be installed during grading operations and prior to placement of asphalt paving. The Contractor shall be required to coordinate their work with these activities by others.

1.6 ACCESS TO SITE

A. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

B. Use of Site: Limit use of Project site to Work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Driveways, Walkways and Entrances: Keep loop road, parking lot entrances, and campus walkways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.

   a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
   b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weather-tight condition throughout construction period. Repair damage caused by construction operations.

D. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.7 COORDINATION WITH OCCUPANTS

A. Full Owner Occupancy: Owner will occupy the campus area outside of and immediately adjacent to the project area and existing and adjacent building(s) during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.

1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.

B. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.

1. ENGINEER will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.
3. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.8 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.

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

B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 6:30 a.m. to 5:30 p.m., Monday through Friday, unless otherwise indicated.
C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:

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

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

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

E. Restricted Substances: Use of tobacco products and other controlled substances on Project site is not permitted.

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

G. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.

1. Maintain list of approved screened personnel with Owner's representative.

1.9 SPECIFICATION AND DRAWING CONVENTIONS

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

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

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

C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard.
3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.
Bowie State University - Car Parking Lot

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000
SECTION 012100 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements governing allowances.

B. Types of allowances include the following:

1. Lump-sum allowances.
2. Unit-cost allowances.
3. Quantity allowances.
4. Contingency allowances.

C. Related Requirements:

1. Section 012200 "Unit Prices" for procedures for using unit prices, including adjustment of quantity allowances when applicable.

1.3 DEFINITIONS

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

1.4 SELECTION AND PURCHASE

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

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

C. Purchase products and systems selected by ENGINEER from the designated supplier.
1.5 ACTION SUBMITTALS

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

1.6 INFORMATIONAL SUBMITTALS

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

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

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

1.7 LUMP-SUM ALLOWANCES

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

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

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

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

1.8 UNIT-COST ALLOWANCES

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

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

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

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

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

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

C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
   1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.10 CONTINGENCY ALLOWANCES

A. Use the contingency allowance only as directed by ENGINEER for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.

B. Contractor's overhead, profit, and related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation, taxes, insurance, equipment rental, and similar costs.

C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit.

D. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

1.11 ADJUSTMENT OF ALLOWANCES

A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
   1. Include installation costs in purchase amount only where indicated as part of the allowance.
   2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other markups.
   3. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit-cost allowances.
   4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.
B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

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

3.3 SCHEDULE OF ALLOWANCES

A. Allowance No. 1: Quantity Allowance: Include 2,500 cu. yd. of unsatisfactory soil excavation and disposal off-site and replacement with engineered fill from off-site, as specified in Section 312000 "Earth Moving."

   1. Coordinate quantity allowance adjustment with unit-price requirements in Section 012200 "Unit Prices."

B. Allowance No. 2: Contingency Allowance: Include a contingency allowance of $100,000.00 for use according to Owner's written instructions. This allowance is established to account for potential changes resulting from final permit approved documents. The Owner is obtaining required stormwater management and erosion & sediment control approvals from the Maryland Department of the Environment (MDE) Water and Science Administration (WSA). The Contractor will be provided with a set of the MDE WSA approved drawings upon contract award. An itemized Change Order will be submitted for review and approval in accordance with the requirements of this Sections to account for changes related with the MDE WSA approved permit set revisions.

END OF SECTION 012100
SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section includes administrative and procedural requirements for unit prices.
B. Related Requirements:
   1. Section 012100 "Allowances" for procedures for using unit prices to adjust quantity allowances.
   2. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
   3. Section 014000 "Quality Requirements" for field testing by an independent testing agency.

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

1.4 PROCEDURES
A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.
3.1 SCHEDULE OF UNIT PRICES

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

1. Description: Unsatisfactory soil excavation and disposal off-site and replacement with engineered fill from off-site, as required, according to Section 312000 "Earth Moving."
2. Unit of Measurement: Cubic yard (Cubic meter) of soil excavated, based on in-place surveys of volume before and after removal.
3. Quantity Allowance: Coordinate unit price with allowance adjustment requirements in Section 012100 "Allowances."

END OF SECTION 012200
SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Execute accepted alternates under the same conditions as other work of the Contract.

C. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.
PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1

1. Base Bid: All work associated with the pedestrian light fixtures including; light poles, fixtures, ductbanks, and electrical connections as indicated on the drawings.

2. Alternate: Addition of all work associated with the area flood light fixtures (parking lot lights) including; light poles, fixtures, ductbanks, and electrical connections as indicated on the drawings.

END OF SECTION 012300
SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:
   1. Section 012300 "Alternates" for products selected under an alternate.

1.3 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

   1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
   2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

   2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
      a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
      b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
      c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section.
Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.

d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of ENGINEERs and owners.
h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project, from ICC.
j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. ENGINEER's Action: If necessary, ENGINEER will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. ENGINEER will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

a. Forms of Acceptance: Change Order, Construction Change Directive, or ENGINEER's Supplemental Instructions for minor changes in the Work.
b. Use product specified if ENGINEER does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.
1.7 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: ENGINEER will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, ENGINEER will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
b. Substitution request is fully documented and properly submitted.
c. Requested substitution will not adversely affect Contractor's construction schedule.
d. Requested substitution has received necessary approvals of authorities having jurisdiction.
e. Requested substitution is compatible with other portions of the Work.
f. Requested substitution has been coordinated with other portions of the Work.
g. Requested substitution provides specified warranty.
h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Not allowed.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500
SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
   B. Related Requirements:
      1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.3 MINOR CHANGES IN THE WORK
   A. ENGINEER will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710.

1.4 PROPOSAL REQUESTS
   A. Owner-Initiated Proposal Requests: ENGINEER will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
      1. Work Change Proposal Requests issued by ENGINEER are not instructions either to stop work in progress or to execute the proposed change.
      2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
         a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
         b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
         c. Include costs of labor and supervision directly attributable to the change.
         d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
e. Quotation Form: Use forms acceptable to ENGINEER.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to ENGINEER.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form acceptable to ENGINEER.

1.5 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Change Proposal Request, ENGINEER will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.6 CONSTRUCTION CHANGE DIRECTIVE


1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

1.7 WORK CHANGE DIRECTIVE

1. Work Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Work Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600
SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
B. Related Requirements:
   1. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
   2. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 DEFINITIONS
A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES
A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule. Cost-loaded Critical Path Method Schedule may serve to satisfy requirements for the schedule of values.
   1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
   2. Submit the schedule of values to ENGINEER at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
   1. Identification: Include the following Project identification on the schedule of values:
      a. Project name and location.
      b. Name of ENGINEER.
      c. ENGINEER's Project number.
d. Contractor's name and address.
e. Date of submittal.

2. Arrange schedule of values consistent with format of AIA Document G703.

3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.

4. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
   a. Differentiate between items stored on-site and items stored off-site.

5. Overhead Costs: Include total cost and proportionate share of general overhead and profit for each line item.

6. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.

7. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.5 APPLICATIONS FOR PAYMENT

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

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

1. Submit draft copy of Application for Payment seven days prior to due date for review by ENGINEER.

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

1. Other Application for Payment forms proposed by the Contractor shall be acceptable to ENGINEER and Owner. Submit forms for approval with initial submittal of schedule of values.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. ENGINEER will return incomplete applications without action.
1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.

E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
3. Provide summary documentation for stored materials indicating the following:
   a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
   b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
   c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

F. Transmittal: Submit five signed and notarized original copies of each Application for Payment to ENGINEER by a method ensuring receipt. One copy shall include waivers of lien and similar attachments if required.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
2. Schedule of values.
3. Contractor's construction schedule (preliminary if not final).
4. Products list (preliminary if not final).
5. Submittal schedule (preliminary if not final).
6. List of Contractor's staff assignments.
8. Initial progress report.
10. Certificates of insurance and insurance policies.
11. Performance and payment bonds.
12. Data needed to acquire Owner's insurance.
H. Application for Payment at Substantial Completion: After ENGINEER issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

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

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

1. Evidence of completion of Project closeout requirements.
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
5. AIA Document G706A.
7. Evidence that claims have been settled.
8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900
SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
   1. General coordination procedures.
   2. RFIs.
   3. Project meetings.

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

C. Related Requirements:
   1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
   2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.

1.3 DEFINITIONS

A. RFI: Request for Information. Request from Owner, ENGINEER, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
   1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
   2. Number and title of related Specification Section(s) covered by subcontract.
   3. Drawing number and detail references, as appropriate, covered by subcontract.
B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1.5 GENERAL COORDINATION PROCEDURES

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

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

B. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its own operations with operations included in different Sections that depend on each other for proper installation, connection, and operation.

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

C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

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

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

1.6 REQUEST FOR INFORMATION (RFI)

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

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

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

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

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

1. Attachments shall be electronic files in PDF format.

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

1. The following Contractor-generated RFIs will be returned without action:
   a. Requests for approval of submittals.
   b. Requests for approval of substitutions.
c. Requests for approval of Contractor's means and methods.
d. Requests for coordination information already indicated in the Contract Documents.
e. Requests for adjustments in the Contract Time or the Contract Sum.
f. Requests for interpretation of ENGINEER's actions on submittals.
g. Incomplete RFIs or inaccurately prepared RFIs.

2. ENGINEER's action may include a request for additional information, in which case ENGINEER's time for response will date from time of receipt by ENGINEER of additional information.

3. ENGINEER's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
   a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify ENGINEER in writing within 10 days of receipt of the RFI response.

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

1. Project name.
2. Name and address of Contractor.
3. Name and address of ENGINEER.
4. RFI number including RFIs that were returned without action or withdrawn.
5. RFI description.
6. Date the RFI was submitted.
7. Date ENGINEER's response was received.
8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

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

1.7 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Use of ENGINEER's Digital Data Files: Digital data files of ENGINEER's CAD drawings will be provided by ENGINEER for Contractor's use during construction.

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

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

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

1.8 PROJECT MEETINGS

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

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and ENGINEER of scheduled meeting dates and times a minimum of 10 working days prior to meeting.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner, and ENGINEER, within three days of the meeting.

B. Preconstruction Conference: ENGINEER will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and ENGINEER, but no later than 15 days after execution of the Agreement.

1. Attendees: Authorized representatives of Owner ENGINEER, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:

   a. Responsibilities and personnel assignments.
   b. Tentative construction schedule.
   c. Phasing.
   d. Critical work sequencing and long lead items.
   e. Designation of key personnel and their duties.
   f. Lines of communications.
   g. Procedures for processing field decisions and Change Orders.
   h. Procedures for RFIs.
   i. Procedures for testing and inspecting.
   j. Procedures for processing Applications for Payment.
   k. Distribution of the Contract Documents.
   l. Submittal procedures.
   m. Sustainable design requirements.
n. Preparation of Record Documents.
o. Use of the premises and existing building.
p. Work restrictions.
q. Working hours.
r. Owner's occupancy requirements.
s. Responsibility for temporary facilities and controls.
t. Procedures for moisture and mold control.
u. Procedures for disruptions and shutdowns.
v. Construction waste management and recycling.
w. Parking availability.
x. Office, work, and storage areas.
y. Equipment deliveries and priorities.
z. First aid.
bb. Progress cleaning.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

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

1. Attendees: Installer and representatives of manufacturers 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 ENGINEER of scheduled meeting dates.

2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

   b. Options.
   c. Related RFIs.
   d. Related Change Orders.
   e. Purchases.
   f. Deliveries.
   g. Submittals.
   h. Possible conflicts.
   i. Compatibility requirements.
   j. Time schedules.
   k. Weather limitations.
   l. Manufacturer's written instructions.
   m. Warranty requirements.
   n. Compatibility of materials.
   o. Acceptability of substrates.
   p. Temporary facilities and controls.
   q. Space and access limitations.
   r. Regulations of authorities having jurisdiction.
   s. Testing and inspecting requirements.
   t. Installation procedures.
   u. Coordination with other work.
Bowie State University – Car Parking Lot

v. Required performance results.
w. Protection of adjacent work.
x. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.

4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.

5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and ENGINEER, but no later than 90 days prior to the scheduled date of Substantial Completion.

1. Conduct the conference to review requirements and responsibilities related to Project closeout.

2. Attendees: Authorized representatives of Owner, ENGINEER, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
   a. Preparation of Record Documents.
   b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
   c. Procedures for completing and archiving web-based Project software site data files.
   d. Submittal of written warranties.
   e. Requirements for completing sustainable design documentation.
   f. Requirements for preparing operations and maintenance data.
   g. Requirements for delivery of material samples, attic stock, and spare parts.
   h. Requirements for demonstration and training.
   i. Preparation of Contractor's punch list.
   j. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
   k. Submittal procedures.
   l. Coordination of separate contracts.
   m. Owner's partial occupancy requirements.
   n. Installation of Owner's furniture, fixtures, and equipment.
   o. Responsibility for removing temporary facilities and controls.

4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

E. Progress Meetings: Conduct progress meetings at biweekly intervals.

1. Coordinate dates of meetings with preparation of payment requests.

2. Attendees: In addition to representatives of Owner and ENGINEER, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in
planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

   a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction 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.

      1) Review schedule for next period.

   b. Review present and future needs of each entity present, including the following:

      1) Interface requirements.
      2) Sequence of operations.
      3) Status of submittals.
      4) Deliveries.
      5) Access.
      6) Site use.
      7) Temporary facilities and controls.
      8) Progress cleaning.
      9) Quality and work standards.
      10) Status of correction of deficient items.
      11) Field observations.
      12) Status of RFIs.
      13) Status of Proposal Requests.
      14) Pending changes.
      15) Status of Change Orders.
      16) Pending claims and disputes.
      17) Documentation of information for payment requests.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

   a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
   1. Startup construction schedule.
   2. Contractor's Construction Schedule.
   3. Material location reports.
   4. Site condition reports.
   5. Unusual event reports.

1.3 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.

   1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
   2. Predecessor Activity: An activity that precedes another activity in the network.
   3. Successor Activity: An activity that follows another activity in the network.

B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.

C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

E. Event: The starting or ending point of an activity.

F. Float: The measure of leeway in starting and completing an activity.
1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

G. Resource Loading: The allocation of manpower and equipment necessary for completing an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:
   1. Working electronic copy of schedule file, where indicated.
   2. PDF file.

B. Startup construction schedule.
   1. Submittal of cost-loaded, startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.

C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.

D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
   1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.

E. Construction Schedule Updating Reports: Submit with Applications for Payment.

F. Daily Construction Reports: Submit at monthly intervals.

G. Material Location Reports: Submit at monthly intervals.

H. Site Condition Reports: Submit at time of discovery of differing conditions.

I. Unusual Event Reports: Submit at time of unusual event.

J. Qualification Data: For scheduling consultant.

1.5 QUALITY ASSURANCE

A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of ENGINEER's request.
B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's Construction Schedule, including, but not limited to, the following:

1. Review software limitations and content and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Discuss constraints, including phasing and work stages.
4. Review delivery dates for Owner-furnished products.
5. Review schedule for work of Owner's separate contracts.
6. Review submittal requirements and procedures.
7. Review time required for review of submittals and resubmittals.
8. Review requirements for tests and inspections by independent testing and inspecting agencies.
9. Review time required for Project closeout and Owner startup procedures.
10. Review and finalize list of construction activities to be included in schedule.
11. Review procedures for updating schedule.

1.6 COORDINATION

A. Coordinate Contractor's Construction Schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

1.7 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

1. Use Microsoft Project or Primavera

B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of final completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by ENGINEER.

3. Startup and Testing Time: Include no fewer than 15 days for startup and testing.

4. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for ENGINEER's administrative procedures necessary for certification of Substantial Completion.

5. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.

D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Phasing: Arrange list of activities on schedule by phase.

2. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.

3. Work Restrictions: Show the effect of the following items on the schedule:
   a. Coordination with existing construction.
   b. Limitations of continued occupancies.
   c. Uninterruptible services.
   d. Partial occupancy before Substantial Completion.
   e. Use-of-premises restrictions.
   g. Seasonal variations.
   h. Environmental control.

4. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
   a. Subcontract awards.
   b. Submittals.
   c. Purchases.
   d. Fabrication.
   e. Sample testing.
   f. Deliveries.
   g. Installation.
   h. Tests and inspections.
   i. Adjusting.
   j. Curing.
   k. Startup and placement into final use and operation.

5. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
   a. Mass grading completion.
   b. Parking lot sub-base completion.
   c. Storm drain installation completion.
   d. Base course paving completion.
   e. Completion of electrical installation.
f. Substantial Completion.

E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.

F. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.

1. See Section 012900 "Payment Procedures" for cost reporting and payment procedures.

G. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.
2. Unanswered Requests for Information.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.
5. Pending modifications affecting the Work and the Contract Time.

H. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting. Contractor shall prepare written two-week look ahead schedule for presentation at regular biweekly construction progress meetings

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate final completion percentage for each activity.

I. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.

J. Distribution: Distribute copies of approved schedule to ENGINEER Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.
1.8 STARTUP CONSTRUCTION SCHEDULE

A. Gantt-Chart Schedule: Submit startup, horizontal, Gantt-chart-type construction schedule within seven days of date established for commencement of the Work.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

1.9 GANTT-CHART SCHEDULE REQUIREMENTS

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for the Notice of Award.

1. Base schedule on the startup construction schedule and additional information received since the start of Project.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

1.10 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
8. Accidents.
9. Meetings and significant decisions.
10. Unusual events.
11. Stoppages, delays, shortages, and losses.
12. Meter readings and similar recordings.
14. Orders and requests of authorities having jurisdiction.
15. Change Orders received and implemented.
16. Construction, Work Change Directives received and implemented.
17. Services connected and disconnected.
18. Equipment or system tests and startups.
19. Partial completions and occupancies.
20. Substantial Completions authorized.

B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:

1. Material stored prior to previous report and remaining in storage.
2. Material stored prior to previous report and since removed from storage and installed.
3. Material stored following previous report and remaining in storage.

C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

D. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

1. Submit unusual event reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013200
SECTI0N 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Preconstruction photographs.
2. Periodic construction photographs.
3. Final completion construction photographs.
4. Preconstruction video recordings.
5. Periodic construction video recordings.

B. Related Requirements:

1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
2. Section 024116 "Structure Demolition" for photographic documentation before building demolition operations commence.
3. Section 311000 "Site Clearing" for photographic documentation before site clearing operations commence.

1.3 INFORMATIONAL SUBMITTALS

A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.

B. Digital Photographs: Submit image files within three days of taking photographs.

1. Submit photos on CD-ROM or thumb-drive. Include copy of key plan indicating each photograph's location and direction.
2. Identification: Provide the following information with each image description in file metadata tag.

a. Name of Project.
b. Date photograph was taken.
c. Description of location, vantage point, and direction.
d. Unique sequential identifier keyed to accompanying key plan.
1.4 QUALITY ASSURANCE

A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three years.

1.5 FORMATS AND MEDIA

A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels. Use flash in low light levels or backlit conditions.

B. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

C. Metadata: Record accurate date and time and GPS location data from camera.

D. File Names: Name media files with date and sequential numbering suffix.

1.6 CONSTRUCTION PHOTOGRAPHS

A. Photographer: Engage a qualified photographer to take construction photographs.

B. General: Take photographs with maximum depth of field and in focus.

1. Maintain key plan with each set of construction photographs that identifies each photographic location.

C. Preconstruction Photographs: Before starting construction, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by ENGINEER.

1. Flag construction limits before taking construction photographs.
2. Take 20 photographs to show existing conditions adjacent to property before starting the Work.
3. Take 20 photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
4. Take additional photographs as required to record settlement or cracking of adjacent, pavements, and improvements.

D. Periodic Construction Photographs: Take minimum of 20 photographs weekly, and coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.

E. Time-Lapse Sequence Construction Photographs: Take 20 photographs as indicated, to show status of construction and progress since last photographs were taken.

1. Frequency: Take photographs weekly, on the same day each week.
2. Vantage Points: Following suggestions by ENGINEER and Contractor, photographer to select vantage points. During each of the following construction phases, take not less than
two of the required shots from same vantage point each time to create a time-lapse sequence as follows:

a. Commencement of the Work, through completion of subgrade construction.
b. Utilities
c. Paving

F. Final Completion Construction Photographs: Take minimum of 50 photographs after date of Substantial Completion for submission as Project Record Documents. ENGINEER will inform photographer of desired vantage points.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013233
SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

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

1.3 DEFINITIONS

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

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

1.4 SUBMITTAL SCHEDULE

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

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.

4. Format: Arrange the following information in a tabular format:

   a. Scheduled date for first submittal.
   b. Specification Section number and title.
   c. Submittal Category: Action; informational.
   d. Name of subcontractor.
   e. Description of the Work covered.
   f. Scheduled date for ENGINEER's and Construction Manager's final release or approval.
   g. Scheduled dates for purchasing.
   h. Scheduled date of fabrication.
   i. Scheduled dates for installation.
   j. Activity or event number.

1.5 SUBMITTAL FORMATS

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

1. Project name.
2. Date.
3. Name of ENGINEER.
4. Name of Construction Manager.
5. Name of Contractor.
6. Name of firm or entity that prepared submittal.
7. Names of subcontractor, manufacturer, and supplier.
8. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.
9. Category and type of submittal.
10. Submittal purpose and description.
11. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
12. Drawing number and detail references, as appropriate.
13. Indication of full or partial submittal.
14. Location(s) where product is to be installed, as appropriate.
15. Other necessary identification.
17. Signature of transmitter.

B. Options: Identify options requiring selection by ENGINEER.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by ENGINEER and Construction Manager on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
D. PDF Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

1. Place a permanent label or title block on each submittal item for identification; include name of firm or entity that prepared submittal.
2. Provide a space approximately 6 by 8 inches (150 by 200 mm) on label or beside title block to record Contractor's review and approval markings and action taken by ENGINEER and Owner.
3. Transmittal for Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using AIA Document G810 transmittal form.

1.6 SUBMITTAL PROCEDURES

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

1. Email: Prepare submittals as PDF package, and transmit to ENGINEER by sending via email. Include PDF transmittal form. Include information in email subject line as requested by ENGINEER.
   a. ENGINEER, through Construction Manager, will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.

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

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections so processing will not be delayed because of need to review submittals concurrently for coordination.
   a. ENGINEER reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

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

1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. ENGINEER will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. **Resubmittal Review:** Allow 15 days for review of each resubmittal.

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

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from ENGINEER's action stamp.

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

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

1.7 **SUBMITTAL REQUIREMENTS**

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

1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:
   a. Manufacturer's catalog cuts.
   b. Manufacturer's product specifications.
   c. Standard color charts.
   d. Statement of compliance with specified referenced standards.
   e. Testing by recognized testing agency.
   f. Application of testing agency labels and seals.
   g. Notation of coordination requirements.
   h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:
   a. Wiring diagrams that show factory-installed wiring.
   b. Printed performance curves.
   c. Operational range diagrams.
   d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before Shop Drawings, and before or concurrent with Samples.

B. **Shop Drawings:** Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on ENGINEER's digital data drawing files is otherwise permitted.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
   a. Identification of products.
   b. Schedules.
   c. Compliance with specified standards.
   d. Notation of coordination requirements.
   e. Notation of dimensions established by field measurement.
   f. Relationship and attachment to adjoining construction clearly indicated.
   g. Seal and signature of professional engineer if specified.

C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
   a. Project name and submittal number.
   b. Generic description of Sample.
   c. Product name and name of manufacturer.
   d. Sample source.
   e. Number and title of applicable Specification Section.
   f. Specification paragraph number and generic name of each item.
3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics, and identification information for record.
4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
   a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
   b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
   a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. ENGINEER will return submittal with options selected.
6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the
following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

a. Number of Samples: Submit two sets of Samples. ENGINEER will retain one Sample sets; remainder will be returned.
   1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
   2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least two sets of paired units that show approximate limits of variations.

D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
   1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
   2. Manufacturer and product name, and model number if applicable.
   3. Number and name of room or space.
   4. Location within room or space.

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

F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

G. Certificates:
   1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
   2. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
   3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
   4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
   5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

H. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

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

3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

   a. Name of evaluation organization.
   b. Date of evaluation.
   c. Time period when report is in effect.
   d. Product and manufacturers' names.
   e. Description of product.
   f. Test procedures and results.
   g. Limitations of use.

1.8 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to ENGINEER.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.9 CONTRACTOR'S REVIEW

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

B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

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

1.10 ENGINEER'S AND OWNER’S REVIEW

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

B. PDF Submittals: ENGINEER will indicate, via markup on each submittal, the appropriate action.

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

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

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

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

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300
SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements. The Contractor shall engage a third-party Testing Agency meeting the requirements specified herein and shall provide all testing and inspection services required for the project at no additional cost to the Owner. This requirement applies to all references to Testing Agency and testing and inspections required throughout the project documents.

1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.

2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.

3. Requirements for Contractor to provide quality-assurance and -control services required by ENGINEER, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

4. Specific test and inspection requirements are not specified in this Section.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by ENGINEER.

C. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
D. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

E. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.

F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

H. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

1.4 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to ENGINEER for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to ENGINEER for a decision before proceeding.

1.5 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data: For Contractor's quality-control personnel.

C. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

D. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

   1. Specification Section number and title.
   2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

1.6 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to ENGINEER. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.

B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.

1. Project quality-control manager may also serve as Project superintendent.

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:

1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work ENGINEER has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.
1.7 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.8 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

1.9 QUALITY CONTROL

A. Contractor Responsibilities: All tests and inspections are the Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

B. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

C. Testing Agency Responsibilities: Cooperate with ENGINEER and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify ENGINEER and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

D. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

E. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to ENGINEER.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for ENGINEER's reference during normal working hours.
3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000
SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:
   1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.
   2. Section 312319 "Dewatering" for disposal of ground water at Project site.

1.3 USE CHARGES

A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, ENGINEER, testing agencies, and authorities having jurisdiction.

B. Sewer Service: Pay sewer-service use charges for sewer usage by all entities for construction operations.

C. Water Service: Pay water-service use charges for water used by all entities for construction operations.

D. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations.

1.4 INFORMATIONAL SUBMITTALS

A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.

B. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.
C. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.

D. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

1.5 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.6 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch-thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch-OD line posts and 2-7/8-inch-OD corner and pull posts, with 1-5/8-inch-OD top and bottom rails. Provide concrete bases for supporting posts.

B. Fencing Windscreen Privacy Screen: Polyester fabric scrim with grommets for attachment to chain link fence, sized to height of fence, in color selected by ENGINEER from manufacturer's standard colors.

C. Wood Enclosure Fence: Plywood, 6 feet high, framed with four 2-by-4-inch rails, with preservative-treated wood posts spaced not more than 8 feet apart.

D. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.

E. Dust-Control Adhesive-Surface Walk-Off Mats: Provide mats minimum 36 by 60 inches.

F. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
2.2 TEMPORARY FACILITIES
   A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
   B. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
      1. Store combustible materials apart from building.

2.3 EQUIPMENT
   A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL
   A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
      1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL
   A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
      1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."
   B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.3 TEMPORARY UTILITY INSTALLATION
   A. General: Install temporary service or connect to existing service.
      1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
   B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

C. Water Service: Connect to existing water service facilities. Clean and maintain water service facilities in a condition acceptable to BSU and utility service provider. At Substantial Completion, restore these facilities to condition existing before initial use.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

E. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.

3.4 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.

2. Maintain support facilities until ENGINEER schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Temporary Use of Planned Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.

1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.

2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Section 312000 "Earth Moving."

3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.

4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to Section 321216 "Asphalt Paving."

C. Traffic Controls: Comply with requirements of authorities having jurisdiction and coordination with Bowie State University and campus police.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.

2. Maintain access for fire-fighting equipment and access to fire hydrants.

D. Parking: Use designated areas of Owner's existing parking areas for construction personnel.
E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

1. Identification Signs: Provide Project identification signs as indicated on Drawings.
2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
   a. Provide temporary, directional signs for construction personnel and visitors.
3. Maintain and touch up signs so they are legible at all times.

G. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

1. Comply with work restrictions specified in Section 011000 "Summary."

C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings.

D. Stormwater Control: As indicated on the drawings.

E. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.

1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations and as indicated on the drawings.
2. Maintain security by limiting number of keys and restricting distribution to authorized personnel.
F. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.

G. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

3.6 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.
   1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
   1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
   2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.

B. Related Requirements:

1. Section 011000 "Summary" for limits on use of Project site.
2. Section 013300 "Submittal Procedures" for submitting surveys.
3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
4. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.

1.3 DEFINITIONS

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

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

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For land surveyor.

B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.
1.5 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

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

1. Structural Elements: When cutting and patching structural elements, notify ENGINEER of locations and details of cutting and await directions from ENGINEER before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.

2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
   a. Electrical wiring systems.

3. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in ENGINEER's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to ENGINEER for the visual and functional performance of in-place materials.
PART 3 - EXECUTION

3.1 EXAMINATION

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

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

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

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

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

1. Description of the Work.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

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

3.2 PREPARATION

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

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to ENGINEER according to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

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

B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
   1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
   2. Establish limits on use of Project site.
   3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
   4. Inform installers of lines and levels to which they must comply.
   5. Check the location, level and plumb, of every major element as the Work progresses.
   6. Notify ENGINEER when deviations from required lines and levels exceed allowable tolerances.
   7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

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

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
   1. Do not change or relocate existing benchmarks or control points without prior written approval of ENGINEER. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to ENGINEER before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

3.5 INSTALLATION

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

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

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

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

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

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

F. Tools and Equipment: Where possible, select tools or equipment that minimize production of excessive noise levels.

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

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by ENGINEER.

2. Allow for building movement, including thermal expansion and contraction.

3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

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

J. Repair or remove and replace damaged, defective, or nonconforming Work.

1. Comply with Section 017700 "Closeout Procedures" for repairing or removing and replacing defective Work.

3.6 CUTTING AND PATCHING

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

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

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of work to be cut.

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

E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 011000 "Summary."

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

G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

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

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
   a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
   b. Restore damaged pipe covering to its original condition.
3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
   a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

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

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

2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
   a. Use containers intended for holding waste materials of type to be stored.
4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

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

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

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

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

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

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

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."

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

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

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

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

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

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

D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.9 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.

C. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300
SECTIO...E 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.
5. Repair of the Work.

B. Related Requirements:

1. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of cleaning agent.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at final completion.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.
1.6 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, and similar final record information.
2. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, final certifications, and similar documents.
3. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, ENGINEER will either proceed with inspection or notify Contractor of unfulfilled requirements. ENGINEER will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by ENGINEER, that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for final completion.

1.7 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of ENGINEER's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by ENGINEER. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit final completion photographic documentation.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, ENGINEER will either proceed with inspection or notify Contractor of unfulfilled requirements. ENGINEER will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Include the following information at the top of each page:

   a. Project name.
   b. Date.
   c. Name of ENGINEER
   d. Name of Contractor.
   e. Page number.

2. Submit list of incomplete items in the following format:

   a. PDF electronic file. ENGINEER will return annotated file.

1.9 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of ENGINEER for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

1. Submit on digital media acceptable to ENGINEER.

D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

   a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
   b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
   c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
   d. Remove tools, construction equipment, machinery, and surplus material from Project site.
   e. Remove snow and ice to provide safe access to parking lot and pedestrian walkways.
   f. Remove labels that are not permanent.
   g. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
   h. Leave Project clean and ready for occupancy.

C. Construction Waste Disposal: Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

B. Repair, or remove and replace, defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
1. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
   a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.

2. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.

END OF SECTION 017700
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory manuals.
2. Emergency manuals.
3. Systems and equipment operation manuals.
4. Systems and equipment maintenance manuals.
5. Product maintenance manuals.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Owner will comment on whether content of operation and maintenance submittals is acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operation and maintenance manuals in the following format:

1. Submit on digital media acceptable to Owner. Enable reviewer comments on draft submittals.
C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Owner will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Owner will return copy with comments.

1. Correct or revise each manual to comply with Owner's comments. Submit copies of each corrected manual within 15 days of receipt of Owner's comments and prior to commencing demonstration and training.

1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Construction Manager.
7. Name and contact information for Owner.
8. Name and contact information for Commissioning Authority.
9. Names and contact information for major consultants to the Owner that designed the systems contained in the manuals.
10. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.7 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:

1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.8 EMERGENCY MANUALS

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Power failure.
3. System, subsystem, or equipment failure.
4. Chemical release or spill.

D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

E. Emergency Procedures: Include the following, as applicable:
   1. Instructions on stopping.
   2. Shutdown instructions for each type of emergency.
   3. Operating instructions for conditions outside normal operating limits.
   4. Required sequences for electric or electronic systems.
   5. Special operating instructions and procedures.

1.9 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.

   1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
   2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

   2. Performance and design criteria if Contractor has delegated design responsibility.
   3. Operating standards.
   4. Operating procedures.
   5. Operating logs.
   6. Wiring diagrams.
   7. Control diagrams.
   8. Piped system diagrams.
   9. Precautions against improper use.
   10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

   1. Product name and model number. Use designations for products indicated on Contract Documents.
   2. Manufacturer's name.
   3. Equipment identification with serial number of each component.
   4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.10 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.

C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

   a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.

3. Identification and nomenclature of parts and components.

4. List of items recommended to be stocked as spare parts.

E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

   1. Test and inspection instructions.
   2. Troubleshooting guide.
   3. Precautions against improper maintenance.
   4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   5. Aligning, adjusting, and checking instructions.
   6. Demonstration and training video recording, if available.

F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

   1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
   2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

   1. Include procedures to follow and required notifications for warranty claims.

J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
1. Do not use original project record documents as part of maintenance manuals.

1.11 PRODUCT MAINTENANCE MANUALS

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Product Information: Include the following, as applicable:
   1. Product name and model number.
   2. Manufacturer's name.
   3. Color, pattern, and texture.
   5. Reordering information for specially manufactured products.

E. Maintenance Procedures: Include manufacturer's written recommendations and the following:
   1. Inspection procedures.
   2. Types of cleaning agents to be used and methods of cleaning.
   3. List of cleaning agents and methods of cleaning detrimental to product.
   4. Schedule for routine cleaning and maintenance.
   5. Repair instructions.

F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
   1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017823
SECTION 024116 - STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Demolition and removal of buildings.
2. Removing below-grade construction.
3. Disconnecting, capping or sealing, and removing site utilities.
4. Salvaging items for reuse by Owner.

B. Related Requirements:

1. Section 011000 "Summary" for use of the premises and phasing requirements.
2. Section 013200 "Construction Progress Documentation" for preconstruction photographs taken before building demolition.
3. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade site improvements not part of building demolition.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse. Include fasteners or brackets needed for reattachment elsewhere.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.
1.5 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at project site.
   1. Inspect and discuss condition of construction to be demolished.
   2. Review structural load limitations of existing structures.
   3. Review and finalize building demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
   4. Review and finalize protection requirements.
   5. Review procedures for noise control and dust control.
   6. Review procedures for protection of adjacent buildings.
   7. Review items to be salvaged and returned to Owner.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.


C. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

D. Schedule of Building Demolition Activities: Indicate the following:
   1. Detailed sequence of demolition work, with starting and ending dates for each activity.
   2. Temporary interruption of utility services.
   3. Shutoff and capping or re-routing of utility services.

E. Predemolition Photographs or Video: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Comply with Section 013233 "Photographic Documentation." Submit before the Work begins.

F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.
1.9 FIELD CONDITIONS

A. Buildings to be demolished will be vacated and their use discontinued before start of the Work.

B. Buildings immediately adjacent to demolition area will be occupied. Conduct building demolition so operations of occupied buildings will not be disrupted.
   1. Provide not less than 72 hours' notice of activities that will affect operations of adjacent occupied buildings.
   2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings.
      a. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from authorities having jurisdiction.

C. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
   1. Hazardous materials will be removed by Owner before start of the Work.
   2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify ENGINEER and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. Hazardous Materials: Present in buildings and structures to be demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
   1. Hazardous material remediation is specified elsewhere in the Contract Documents.
   2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
   3. Owner will provide material safety data sheets for materials that are known to be present in buildings and structures to be demolished because of building operations or processes performed there.

F. On-site storage or sale of removed items or materials is not permitted.

1.10 COORDINATION

A. Arrange demolition schedule so as not to interfere with Owner's on-site operations.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ASSE A10.6 and NFPA 241.

2.2 SOIL MATERIALS

A. Satisfactory Soils: Comply with requirements in Section 312000 "Earth Moving."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during building demolition operations.

D. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.

E. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

F. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations. Comply with Section 013233 "Photographic Documentation.

3.2 PREPARATION

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

B. Salvaged Items: Comply with the following:

1. Clean salvaged items of dirt and demolition debris.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to storage area designated by Owner.
5. Protect items from damage during transport and storage.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Utilities to be Disconnected: Locate, identify, disconnect, and seal or cap off utilities serving buildings and structures to be demolished.

1. Owner will arrange to shut off utilities when requested by Contractor.
2. Arrange to shut off utilities with utility companies.
3. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
4. Cut off pipe or conduit a minimum of 24 inches below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.
5. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.4 PROTECTION

A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings.

B. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of demolition.

C. Existing Utilities to Remain: Maintain utility services to remain and protect from damage during demolition operations.

1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.
2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and authorities having jurisdiction.
   a. Provide at least 72 hours' notice to occupants of affected buildings if shutdown of service is required during changeover.

D. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated. Comply with requirements in Section 015000 "Temporary Facilities and Controls."

1. Protect adjacent buildings and facilities from damage due to demolition activities.
2. Protect existing site improvements, appurtenances, and landscaping to remain.
3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
4. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
5. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
6. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
7. Erect and maintain dustproof partitions and temporary enclosures to limit dust, noise, and dirt migration to occupied portions of adjacent buildings.

E. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.5 DEMOLITION, GENERAL
A. General: Demolish indicated buildings and site improvements completely. Use methods required to complete the Work within limitations of governing regulations and as follows:
   1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
   2. Maintain fire watch during and for at least 30 minutes after flame-cutting operations.
   3. Maintain adequate ventilation when using cutting torches.
   4. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

B. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
   1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed trafficways if required by authorities having jurisdiction.
   2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

C. Explosives: Use of explosives is not permitted.

3.6 DEMOLITION BY MECHANICAL MEANS
A. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.

B. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
1. Remove structural framing members and lower to ground by method suitable to minimize
ground impact and dust generation.

C. Salvage: Items to be removed and salvaged are indicated on Drawings.

D. Below-Grade Construction: Demolish foundation walls and other below-grade construction.

   1. Remove below-grade construction, including basements, foundation walls, and footings,
      completely to depths indicated.

E. Existing Utilities: Demolish existing utilities and below-grade utility structures that are within 5
feet outside footprint indicated for new construction. Abandon utilities outside this area.

   1. Fill abandoned utility structures with satisfactory soil materials according to backfill
      requirements in Section 312000 "Earth Moving."

F. Existing Utilities: Demolish and remove existing utilities and below-grade utility structures.

G. Hydraulic Elevator Systems: Demolish and remove elevator system, including cylinder,
plunger, well assembly, steel well casing and liner, oil supply lines, and tanks.

3.7 SITE RESTORATION

A. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building
demolition operations with satisfactory soil materials according to backfill requirements in
Section 312000 "Earth Moving."

B. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free
from irregular surface changes. Provide a smooth transition between adjacent existing grades
and new grades.

3.8 REPAIRS

A. Promptly repair damage to adjacent buildings caused by demolition operations.

3.9 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved
construction and demolition waste landfill acceptable to authorities having jurisdiction.

   1. Do not allow demolished materials to accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces
      and areas.

B. Do not burn demolished materials.
3.10 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations. Return adjacent areas to condition existing before building demolition operations began.

1. Clean roadways of debris caused by debris transport.

END OF SECTION 024116
SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.
B. Related Requirements:
   1. Section 321313 "Concrete Paving" 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, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS
A. Preinstallation Conference: Conduct conference at project site.
   1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
      a. Contractor's superintendent.
      b. Independent testing agency responsible for concrete design mixtures.
      c. Ready-mix concrete manufacturer.
      d. Concrete Subcontractor.
      e. Special concrete finish Subcontractor.
   2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, concrete repair procedures, and concrete protection.
1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

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. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

1. Location of construction joints is subject to approval of the ENGINEER.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. 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. Waterstops.
6. Curing compounds.
7. Repair materials.

D. Material Test Reports: For the following, from a qualified testing agency:

1. Aggregates.

E. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer, detailing fabrication, assembly, and support of formwork.

1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.

F. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

G. Field quality-control reports.
Bowie State University – Car Parking Lot

H. Minutes of preinstallation conference.

1.7 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.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

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. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures.

1.9 DELIVERY, STORAGE, AND HANDLING

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

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

1.10 FIELD CONDITIONS

A. 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 (ACI 301M).
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.

B. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and ACI 305.1 (ACI 305.1M), 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.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

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

1. ACI 301 (ACI 301M).
2. ACI 117 (ACI 117M).

2.2 FORM-FACING MATERIALS

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

1. Plywood, metal, or other approved panel materials.
2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
   a. High-density overlay, Class 1 or better.
   b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
   c. Structural 1, B-B or better; mill oiled and edge sealed.
   d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

F. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

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


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

1. Furnish units that leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
2. Furnish ties that, when removed, 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. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

C. Galvanized Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed bars, ASTM A 767/A 767M, Class I zinc coated after fabrication and bending.

D. Epoxy-Coated Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed bars, ASTM A 775/A 775M, epoxy coated, with less than 2 percent damaged coating in each 12-inch (300-mm) bar length.

E. Stainless-Steel Reinforcing Bars: ASTM A 955/A 955M, Grade 60 (Grade 420), Type 304, deformed.

F. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60 (Grade 420), deformed bars, assembled with clips.
G. Plain-Steel Wire: ASTM A 1064/A 1064M, as drawn.
H. Deformed-Steel Wire: ASTM A 1064/A 1064M.
I. Epoxy-Coated Wire: ASTM A 884/A 884M, Class A, Type 1 coated, as-drawn -steel wire, with less than 2 percent damaged coating in each 12-inch (300-mm) wire length.
J. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from as-drawn steel wire into flat sheets.
L. Galvanized-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from galvanized-steel wire into flat sheets.
M. Epoxy-Coated Welded-Wire Reinforcement: ASTM A 884/A 884M, Class A coated, Type 1, plain steel.

2.4 REINFORCEMENT ACCESSORIES
A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, cut true to length with ends square and free of burrs.
B. Epoxy-Coated Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, ASTM A 775/A 775M epoxy coated.
C. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775/A 775M.
D. Zinc Repair Material: ASTM A 780/A 780M.
E. 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. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
   3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.5 CONCRETE MATERIALS
A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
B. Cementitious Materials:
Bowie State University – Car Parking Lot

1. Portland Cement: ASTM C 150/C 150M, Type I.
2. Fly Ash: ASTM C 618, Class F.
3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.

C. Normal-Weight Aggregates: ASTM C 33/C 33M, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 1-1/2 inches (38 mm) nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Air-Entraining Admixture: ASTM C 260/C 260M.

E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM 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.

F. 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.

G. 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.

H. Water: ASTM C 94/C 94M.

2.6 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.7 CURING MATERIALS

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

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
CAST-IN-PLACE CONCRETE 033000 - 8

Bowie State University – Car Parking Lot

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating.

G. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating.

H. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

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

2.8 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.

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 1/4 inch (6.4 mm) and that can be filled in over a scarified surface to match adjacent floor elevations.

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.

2.9 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 (ACI 301M).
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.
4. Combined Fly Ash or Pozzolan and Slag Cement: 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, Slag Cement, 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 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a w/c 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.

2.10 FABRICATING REINFORCEMENT

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

2.11 CONCRETE MIXING

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

1. 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 INSTALLATION

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301 (ACI 301M), 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 (ACI 117M).

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

1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.
2. Class B, 1/4 inch (6 mm) for rough-formed finished surfaces.

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

E. Construct 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 ITEM INSTALLATION

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 303.

2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3. Install dovetail anchor slots in concrete structures as indicated.

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. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support 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 are not 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 ENGINEER.

3.4 SHORING AND RESHORING INSTALLATION

A. Comply with ACI 318 (ACI 318M) and ACI 301 (ACI 301M) for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. 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-RETARDER INSTALLATION

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder 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 bituminous vapor retarder according to manufacturer's written instructions.

3.6 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting 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 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/D 1.4M, 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.

F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

G. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material according to ASTM A 780/A 780M. Use galvanized-steel wire ties to fasten zinc-coated steel reinforcement.
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 ENGINEER.

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. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
6. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. 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 WATERSTOP INSTALLATION

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.9 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by ENGINEER.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 (ACI 301M).

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 is 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 not to 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 (ACI 301M).
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. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

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

3.10 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.

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.

3.11 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. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6 mm) in one direction.
1. Apply scratch finish to surfaces indicated.

C. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, 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 ENGINEER before application.

3.12 MISCELLANEOUS CONCRETE ITEM INSTALLATION

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

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 4 inches (100 mm high unless otherwise indicated, and extend base not less than 6 inches (150 mm) in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.13 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 305.1 (ACI 305.1M) 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 remainder of 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 does 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. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

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.
3.14 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 [six] 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 joints 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.

3.15 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by ENGINEER. Remove and replace concrete that cannot be repaired and patched to ENGINEER’s approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 (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 to solid concrete. Limit cut depth to 3/4 inch (19 mm). 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 matches 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 ENGINEER.

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 ENGINEER’s approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to ENGINEER’s approval.

3.16 FIELD QUALITY CONTROL

A. Special Inspections: Contractor shall engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Agency: Contractor shall 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 and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. 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/C 172M 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 provides 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/C 231M, pressure method, for normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight 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 or 80 deg F (27 deg C) and above, and one test for each composite sample.

6. Unit Weight: ASTM C 567/C 567M, 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 ENGINEER, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete mix.
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 ENGINEER 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 ENGINEER. 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 ENGINEER.

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.

END OF SECTION 033000
SECTION 260010 - ELECTRICAL GENERAL PROVISIONS

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 SCOPE
A. General: The provisions of this section are general and are intended to apply to all electrical sections, to govern the quality of design, fabrication, workmanship and operation of materials, equipment and appurtenances to be furnished and/or installed thereunder.
B. Equipment: All electrical equipment, including but not limited to, wiring devices, wiring materials and electrical construction materials shall be new and of the highest quality and latest improved design.
C. Workmanship: Workmanship shall be of the highest grade and all installation work shall be performed by thoroughly qualified mechanics of the appropriate trade. All equipment shall be installed and connected in accordance with the best engineering practice. Manufacturer's instructions and recommendations shall be followed and all electric connections shall be provided.
D. Completeness: The Contractor shall furnish all labor, materials, tools, equipment and services necessary for the complete electrical system ready for continuous operation. Provide all required mounting hardware and accessories to install all equipment and devices. Make all equipment and devices fully operational.
E. Drawings: The drawings showing the layout of the electrical system indicate approximate locations of outlets, apparatus and equipment. The runs of feeders and branches as shown, the drawings are schematic only and are not intended to show the exact routing and location of conduits and conduit terminations. The final determination as to routing, location and termination shall be governed by structural conditions, obstructions and job conditions. This shall not be construed to mean that the design of the system may be changed without the written approval of the Engineer; it merely refers to the exact run of raceways and the exact placement of outlets, etc. It shall be the Contractor's responsibility to obtain all shop drawings affecting conduit terminations to the equipment specified in this or other sections or furnished by others, and to verify conduit locations before installation. The Contractor shall consult all contract drawings and specifications which may affect the location of any outlet, equipment or conduit run, to avoid improper locations of such items and to avoid interference with other trades.
F. Accessibility: Electrical equipment such as junction and pull boxes, panelboards, switches, controls and such other apparatus as may require maintenance or operation from time to time, is made easily accessible. Although the equipment may be shown on the drawings in certain locations, in the course of building construction, it may develop that such locations do not
afford proper accessibility, in which case the Contractor shall direct the Engineer's attention to the condition before advancing the construction.

G. Site examinations: All bidders, prior to submitting a bid, shall thoroughly acquaint themselves with the conditions under which the work will be performed. No allowance shall be made subsequently in connection with this, for any error or negligence on the contractor’s part.

H. Unless noted as “existing” or “relocated”, all construction is new and shall be furnished and installed by the contractor.

1.3 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Comply with electrical construction code requirements of State, City and such other local political subdivision specifications as may exceed the requirements of national codes, standards and approving bodies.

B. All electrical equipment installed under this contract shall bear UL label. Equipment shall be installed in accordance with the requirements of UL and the manufacturer.

C. Comply with the National Electrical Code.

D. Certificates and Permits: Upon completion of work, and prior to final payment, furnish to the Engineer formal certification of final inspections from authorities having jurisdiction and secure required permits or certificates (if any) from such authorities. Additionally, prepare detailed diagrams and drawings which may be required by those authorities having jurisdiction. All the cost for obtaining certificates and permits will be paid by the Contractor.

1.4 REFERENCES AND DEFINITIONS

A. Basic References: The following codes, standards, and approvals as referenced throughout the Sections of Division 26, shall serve as the minimum standards and quality requirements directly appropriate to the work and workmanship. References to catalogs, standards, codes, specifications and recommendations, etc., means latest edition of such publications in effect at the date of invitation to submit bid.


2. National Electric Manufacturer's Association (NEMA) Standards as apply to specified Products.

3. National Fire Protection Association (NFPA): NFPA 70 (National Electrical Code), NFPA 72 (National Fire Alarm Code), NFPA 70E (Standard for Electrical Safety Requirements for Employee Workplaces), and other applicable NFPA codes


5. Americans with Disabilities Act (ADA)

6. Institute of Electrical and Electronics Engineers, Inc (IEEE)

7. National Electrical Contractor’s Association (NECA)

8. International Electrical Testing Association (NETA)

9. Occupational Safety and Health Administration (OSHA)
B. Definitions:

1. “Provide” - means “furnish and install”
2. “Indicated” - means “indicated in contract documents”
3. “Concealed” - means items referred to are hidden from normal sight, this includes items partly excavated or crawl spaces and in service tunnels used solely for repairs and maintenance
4. “Exposed” - means items are not “concealed”
5. “Feeder” - means “All circuit conductors between the service equipment, the source of a separately derived system, or other power supply source and the final branch-circuit overcurrent device”
8. “Building” – A structure that stands alone or that is cut off from adjoining structures by fire walls with all openings therein protected by approved fire doors
9. “degrees C” – means “degrees Celsius”
10. “degrees F” – means “degrees Fahrenheit”

1.5 SUBMITTALS

A. Product Data: Submit Product Data applicable to items listed under Submittals in each Section of Division 16; and such items as may be indicated on the Drawings.

B. Shop Drawings

1. General: The Contractor shall submit to the Engineer for approval, before fabrication, detailed shop drawings for all electrical equipment and materials.
2. Shop drawings shall clearly indicate, using arrows and/or highlighting on all copies, which items are being submitted and that each item being submitted is in compliance with all requirements on the drawings and in these specifications. All pertinent specification and drawing requirements shall be indicated on the manufacturer’s drawings. Complete model number of equipment shall be indicated.
3. Shop drawings of related equipment shall be submitted together.

C. "As-Built" Drawings:

1. Accurate project record drawings and specifications, showing in red ink on the working drawings and electrical drawings all changes from the original plans made during installation of the work. Upon completion of the work the contractor shall deliver to the Owner one neat set of drawings with alterations and notations made in red ink.

D. Operating and Maintenance Manuals

1. General: Upon completion of the work, the Contractor shall furnish Operating and Maintenance Manuals for use by the Owner. The manuals shall include operating and maintenance information on all systems and items of equipment. The data shall consist of catalogs, brochures, bulletins, charts, schedules and drawings describing location, operation, maintenance, lubrication, operating weight and other information necessary for the Owner to establish an effective operating and maintenance program.
2. Shop Drawings: Copies of appropriate shop drawings shall be included in the Operating and Maintenance Manuals. The requirements for manuals is a separate contractual item and in no way supersedes the requirements for shop drawings and vice-versa.

3. Approval: Completed manuals shall be submitted to the Engineer for review and approval. Incomplete or inadequate manuals will be returned to the Contractor for correction and resubmission.

4. Provide 3 copies of each operating and maintenance manual unless a greater quantity is specified elsewhere in the specifications, in which case the higher quantity will apply.

5. Equipment keys and passwords shall be provided to the Owner’s authorized representative or representatives. A document shall be provided indicating who received the keys and what are the passwords. Document shall be neat and typewritten.

6. All factory and field test reports shall be included into the O&M Manuals.

7. Provide a separate section in the O&M Manuals for maintenance testing schedules of all equipment. A factory authorized representative of the equipment manufacturer shall certify the maintenance program. Include calendar schedule in table format to indicate all maintenance actions included during the warranty period with spaces for future testing.

8. Records of all factory and field tests by the contractor, manufacturer, or independent testing company shall be included in the O&M Manuals.

9. Wiring diagrams for all factory and field wiring shall be included in the O&M Manuals.

E. Spare Parts and Accessories List

1. A complete list of spare parts and Accessories for equipment shall be provided.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and equipment to the Project site in a clean condition with openings plugged or capped (or otherwise sealed by packaging) both during shipping and during temporary storage.

B. Delivered electrical equipment crating and/or packaging shall clearly identify pick-points or lift-points. In the absence of crating or packaging, pick-points or lift-points must be identified on the equipment.

C. When unloading materials and equipment provide special lifting harness or apparatus as may be required by manufacturers. Handle materials and equipment in accordance with manufacturer's written instructions.

D. The Contractor shall determine the required equipment needed for unloading operations and have such equipment on site to perform unloading work on the date of equipment delivery.

E. Store materials and equipment, both on and off site, in accordance with manufacturer's written instructions. Keep equipment in a dry location.

1. Temporary Heating: Apply temporary heat to materials and equipment, according to manufacturer's written instructions, throughout periods when environment is not controlled for temperature and humidity within manufacturer's stipulated service conditions.
1.7 WARRANTY
A. The Contractor shall guarantee that all work performed and all materials and equipment installed by him are free from defects. He shall repair or replace any defective equipment, materials or workmanship, free of cost to the Owner for a period of two (2) years from date of acceptance. Where individual specification sections indicate a Special Warranty period longer than two (2) years, the longer warranty period shall apply.

B. During this warranty period the Contractor shall:
   1. Correct and make good all electrical defects. Faulty equipment and materials shall be repaired or replaced as required to produce satisfactory results as directed by the engineer and without additional cost to the Owner. Contractor shall provide service within 24 hours after the call has been made by the Owner.

1.8 DAMAGE TO OTHER WORK
A. Damage: Cutting or damage to existing structures, surfaces or installations shall be repaired at the expense of the Contractor. All such repairs or patching shall be done by mechanics of the appropriate trade and shall be neatly done and in such a fashion as to leave no readily apparent joint or change in appearance, and to leave no structural or other weakness.

1.9 TEMPORARY POWER
A. Contractor shall be entirely responsible for temporary power. All applications, fees, temporary connections, etc. shall be made by the contractor.

1.10 COORDINATION
A. General: The Contractor shall coordinate the work performed and equipment furnished by the Electrical Contractor with work performed and equipment furnished by other trades to ensure a complete and satisfactory installation.

1.11 INTERRUPTION OF ELECTRIC SERVICE
A. Do not interrupt electric, telephone or cable tv service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
   1. Notify Construction Manager no fewer than 10 days in advance of proposed interruption of electric service.
   2. Do not proceed with interruption of electric service without Construction Manager's written permission.

END OF SECTION 260010
SECTION 260051 - COMMON WORK RESULTS FOR ELECTRICAL

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. Section Includes:
   1. Electrical equipment coordination and installation.
   2. Sleeves for raceways and cables.
   3. Sleeve seals.
   5. Touch up paint
   6. Common electrical installation requirements.

1.3 DEFINITIONS
A. EPDM: Ethylene-propylene-diene terpolymer rubber.
B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS
A. Product Data: Provide product data for all items indicated in this specification section.

1.5 COORDINATION
A. Coordinate arrangement, mounting, and support of electrical equipment:
   1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
   2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
   3. To allow right of way for piping and conduit installed at required slope.
   4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.

D. Coordinate sleeve selection and application with selection and application of firestopping.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

A. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

B. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:
   a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
   b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Metraflex Co.
   d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.

3. Pressure Plates: Carbon steel. Include two for each sealing element.

4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
2.4 ACCESS DOORS

A. Door and frame shall be constructed of steel, 16 gauge minimum. Access door shall have a continuous piano hinge. Door shall have a flush mounted lock. Finish shall be prime coat of rust inhibitive electrostatic powder, baked enamel. Access door shall be field painted to match the surrounding wall or ceiling.

B. Provide fire rated access doors to maintain the fire rating of wall and ceiling assemblies, to restore original fire-resistance rating of assembly.

2.5 DUCT-SEALING COMPOUND

A. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, and not deterious to cable insulation. Capable of adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals. Sealing compound will not flow up to 250 degrees F. Sealing compound will not become brittle at minus 30 degrees F. Duct-Sealing compound shall be O-Z Gedney DUX 1 or DUX 5, or approved equal.

2.6 TOUCH UP PAINT

A. Provide touch up paint from the manufacturer of the electrical equipment. Paint shall match the finish of the equipment. At a minimum, provide touch up paint for the following equipment:
   1. Panelboards, electrical cabinets, and enclosures.
   2. Electrical switchgear and switchboards.
   3. Disconnect switches.
   4. Enclosed circuit breakers.
   5. Motor starters.
   7. Generator Enclosures
   8. Enclosed Bus Assemblies
   9. Wireways
   10. Surface raceway

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Comply with NFPA 70, National Electrical Code.

C. Measure indicated mounting heights to bottom of unit for suspended items and to bottom of unit for wall-mounting items, unless otherwise noted.

D. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
E. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

F. Right of Way: Give to piping systems installed at a required slope.

G. Where underground ducts or conduit enter the building, the inside of the ducts or conduit shall be sealed with Duct-Sealing Compound.

H. Where underground ducts or conduit stub up at outdoor transformers, including utility transformers, the inside of the ducts or conduit shall be sealed with Duct-Sealing Compound.

I. Provide touch up paint as required on equipment finishes that have been scratched, and provide touch up paint as directed by the engineer. Touch up paint shall be provided in accordance with the manufacturer’s recommendations. Do not allow paint to come in contact with conductors, insulation or any live parts. All nameplates and labels shall remain visible and legible.

J. Overcurrent devices shall be readily accessible and shall be installed so that the center of the grip of the operating handle of the switch or circuit breaker, when in its highest position, is not more than 6 feet 7 inches above the floor or working platform.

K. Provide access doors where required to keep concealed electrical devices and equipment accessible in accordance with the National Electrical Code.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches above finished floor level.

G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials.

K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated ceiling, floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly.

B. Install UL Listed Firestopping Material in accordance with the manufacturer’s recommendations, and UL’s requirements.
SECTION 260060 - GROUNDING AND BONDING

PART 1 - GENERAL

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

1.2 SUMMARY
   A. This Section includes methods and materials for grounding systems and equipment.

1.3 SUBMITTALS
   A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE
   A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
   B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS
   A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise noted.
   B. Bare Copper Conductors:

2.2 CONNECTORS
   A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch diameter by 10 foot long.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller (exception: conductors for vibrating equipment, such as transformers, motors and generators, shall use stranded conductors), and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.

B. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
3. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.

C. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed,
connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

D. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, using a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.

1. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts.

END OF SECTION 260060
SECTION 260073 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

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

1.2 SUMMARY
   A. This Section includes the following:
      1. Hangers and supports for electrical equipment and systems.
      2. Construction requirements for concrete bases.

1.3 DEFINITIONS
   A. RMC: Rigid metal conduit.
   B. MFMA: Metal Framing Manufacturer’s Association

1.4 PERFORMANCE REQUIREMENTS
   A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
   B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
   C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS
   A. Product Data: For the following:
      1. Steel slotted support systems.

1.6 QUALITY ASSURANCE
   A. Comply with NFPA 70.
1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Allied Tube & Conduit.
   b. Cooper B-Line, Inc.; a division of Cooper Industries.
   c. ERICO International Corporation.
   d. Thomas & Betts Corporation.
   e. Unistrut; Tyco International, Ltd.
   f. Hilti

2. Outdoors:
   a. Steel Channel Metallic Coatings: Hot-dip galvanized after fabrication in accordance with ASTM 123 and applied according to MFMA-4.
   b. Fittings and Accessories:
      1) Conduit hangers, conduit clamps, beam clamps, and wall brackets shall be steel, hot-dip galvanized after fabrication in accordance with ASTM 123.
      2) Threaded hardware such as mechanical expansion anchors, nuts, bolts, and threaded rods shall be steel, hot-dip galvanized after fabrication in accordance with ASTM 123. Threaded hardware not available as hot-dip galvanized after fabrication shall be stainless steel type 304.

3. Indoors:
   a. Steel Channel metallic Coatings: Pre-Galvanized Steel with mill galvanized coating designation G90.
   b. Fittings and Accessories:
      1) Conduit hangers, conduit clamps, beam clamps, and wall brackets shall be pre-galvanized (designation G90) or electroplated zinc (ASTM B633).
      2) Threaded hardware shall be electroplated zinc (ASTM B633).

4. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Mechanical-Expansion Anchors: Insert-wedge-type, steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
   a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) Cooper B-Line, Inc.; a division of Cooper Industries.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti Inc.
      4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      5) MKT Fastening, LLC.

2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

5. Toggle Bolts: All-steel springhead type.


7. Inside and outside of Salt Burn and Lean-To, comply with the following:
   a. Pipe clamps, pipe straps, channel nut, clamp back spacers, beam clamps, threaded rods and other support components shall be PVC coated (20 mil gray PVC coating throughout, factory applied) galvanized steel. If PVC coating is not available, provide stainless steel type 316. Threaded hardware that are not available with PVC coating (anchors, nuts, bolts, concrete inserts), shall be stainless steel type 316.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
6. To Light Steel: Sheet metal screws.
7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3500-psi, 28-day compressive-strength concrete, unless otherwise indicated.

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

D. Concrete Pad Protection and Curing:
   1. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
   2. Cure concrete for at least 28 days

3.4 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260073
SECTION 260075 - ELECTRICAL IDENTIFICATION

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 SUBMITTALS
   A. Product Data: For each electrical identification product indicated.

1.3 QUALITY ASSURANCE
   A. Comply with NFPA 70.

1.4 COORDINATION
   B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
   C. Coordinate installation of identifying devices with location of access panels and doors.
   D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS
   A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
   B. Color for Printed Legend:
      1. Power Circuits: Black letters on an orange field.
      2. Instrumentation and Control Circuits: Black letters on a yellow field.
3. Legend: Indicate system or service and voltage, if applicable.

C. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.

2.2 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

C. Write-On Tags: Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and polyester or nylon tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.3 UNDERGROUND-LINE WARNING TAPE

A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.

1. Not less than 6 inches wide by 4 mils thick.
2. Compounded for permanent direct-burial service.
3. Embedded continuous metallic strip or core.
4. Printed legend shall indicate type of underground line.

2.4 WARNING LABELS AND SIGNS


B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

2.5 INSTRUCTION SIGNS

A. Self-Adhesive Instruction Signs: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

2.6 EQUIPMENT IDENTIFICATION LABELS

A. Self-Adhesive, Engraved, Laminated Acrylic or Phenolic Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.
2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
   2. Tensile Strength: 50 lb, minimum.
   3. Temperature Range: Minus 40 to plus 185 deg F.

PART 3 - EXECUTION

3.1 APPLICATION

A. Power-Circuit Conductor Identification: For primary and secondary conductors No. 4/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use write-on tags. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.

B. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use marker tape. Identify each ungrounded conductor according to source and circuit number.

C. Locations of Underground Lines: Provide underground-line warning tape for direct buried and concrete encased ducts or ductbanks.

D. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.

1. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.

E. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:
   a. Indoor Equipment: Adhesive film label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where 2 lines of text are required, use labels 2 inches high.
   b. Outdoor Equipment: Adhesive film label with clear protective overlay

2. Equipment to Be Labeled:
a. Panelboards, electrical cabinets, and enclosures.
b. Access doors and panels for concealed electrical items.
c. Electrical switchgear and switchboards.
d. Disconnect switches.
e. Enclosed circuit breakers.
f. Motor starters.

3.2 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.

1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.
2. Colors for 208/120-V and 240/120V Circuits:
   a. Phase A: Black.
   b. Phase B: Red.
   c. Phase C: Blue.
   d. Neutral: White
3. Colors for 480/277-V Circuits:
   b. Phase B: Orange.
   c. Phase C: Yellow.
   d. Neutral: Gray

4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

F. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 12 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 36 inches overall.

END OF SECTION 260075
SECTION 260119 - UNDERGROUND DUCTS AND UTILITY STRUCTURES

PART 1 - GENERAL

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

1.2 SUMMARY
   A. This Section includes the following:
      1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks, and in single duct runs.

1.3 DEFINITION
   A. RNC: Rigid nonmetallic conduit.
   B. OSHA: Occupational Safety and Health Administration

1.4 SUBMITTALS
   A. Product Data: For each type of product indicated.
   B. Shop Drawings for Precast Manholes and Handholes, or Factory-Fabricated Underground Utility Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:
      1. Duct entry provisions, including locations and duct sizes.
      2. Reinforcement details.
      3. Frame and cover design and manhole and handhole frame support rings.
      4. Ladder details.
      5. Grounding details.
      6. Dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
      7. Joint details.
      8. Structural Calculations
      9. Shop drawings, manhole/handhole drawings, and structural calculations and shall be signed and sealed by a Professional Engineer licensed in the State of Maryland.
   C. Duct-Bank Coordination Drawings: Show duct plans, duct profiles and coordination with other utilities and underground structures.
      1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
D. Field quality-control test reports.

E. Product Certificates: For concrete and steel used in precast concrete manholes and handholes, as required by ASTM C 858.

F. Shop Drawings for Factory-Fabricated Handholes and Boxes Other Than Precast Concrete: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:

1. Duct entry provisions, including locations and duct sizes.
2. Cover design.
4. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

1.5 QUALITY ASSURANCE

A. Comply with ANSI C2.

B. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

1.7 COORDINATION

A. Coordinate elevation, layout and installation of ducts with final arrangement of other utilities, site grading, and surface features as determined in the field.

B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by the Owner and/or the Engineer.

PART 2 - PRODUCTS

2.1 CONDUIT

A. RNC: NEMA TC 2, Type EPC-40-PVC (PVC Schedule 40) and Type EPC-80-PVC (PVC Schedule 80), UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B. RNC shall be sunlight resistant and rated for use with 90 degree C conductors.
2.2 DUCT ACCESSORIES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Cantex, Inc.
   2. Condux International, Inc.
   3. Lamson & Sessions; Carlon Electrical Products.
   4. Manhattan/CDT; a division of Cable Design Technologies.
   5. Spiraduct/AFC Cable Systems, Inc.

B. Duct Accessories:
   1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.

2.3 PRECAST CONCRETE MANHOLES AND HANDHOLES

A. Comply with ASTM C 858, and with interlocking mating sections, complete with accessories, hardware, and features.
   1. Duct Entrances in Manhole and Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
      a. Type and size shall match fittings to duct or conduit to be terminated.
      b. Fittings shall align with elevations of approaching ducts and be located near interior corners of manholes and handholes to facilitate racking of cable.

B. Concrete Knockout Panels: 1-1/2 to 2 inches thick, for future conduit entrance and sleeve for ground rod.

C. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

D. Precast Manholes and Handholes, when buried, shall be designed to support AASHTO HS20 loading.

2.4 UTILITY STRUCTURE ACCESSORIES

A. Manhole and Handhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole and handhole.
   1. Frame and Cover: Weatherproof, gray cast iron complying with ASTM A 48/A 48M, Class 30B, with milled cover-to-frame bearing surfaces; 30" diameter clear opening, heavy duty.
b. Frame and Cover shall be Neenah R-1743 or approved equal.

2. Cover Legend: Cast in. Selected to suit system.
a. Legend: As indicated on the drawings.

3. Manhole and Handhole Chimney Components: Precast concrete rings, HS-20 rated, with dimensions matched to those of roof opening.
a. Mortar for Chimney Ring and Frame and Cover Joints: Comply with ASTM C 270, Type M, except for quantities less than 2.0 cu. ft. where packaged mix complying with ASTM C 387, Type M, may be used.

B. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch- diameter eye, and 1-by-4-inch bolt.
1. Working Load Embedded in 6-Inch, 4000-psi Concrete: 13,000-lbf minimum tension.

C. Pulling-In and Lifting Irons in Concrete Floors: 7/8-inch- diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.
1. Ultimate Yield Strength: 40,000-lbf shear and 60,000-lbf tension.

D. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch ID by 2-3/4 inches deep, flared to 1-1/4 inches minimum at base.
1. Tested Ultimate Pullout Strength: 12,000 lbf minimum.

E. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch bolt, 5300-lbf rated pullout strength, and minimum 6800-lbf rated shear strength.

F. Cable Rack Assembly: Nonmetallic. Components fabricated from nonconductive, fiberglass-reinforced polymer.
1. Stanchions: Nominal 36 inches high by 4 inches wide, with minimum of 9 holes for arm attachment.
a. A minimum of 4 stanchions shall be located on each short wall of the manhole (2 in the upper half and 2 in the lower half of the manhole).
b. A minimum of 8 stanchions shall be located on each long wall of the manhole (4 in the upper half and 4 in the lower half of the manhole).
c. A minimum of 2 stanchions shall be located on each short wall of the handhole.
d. A minimum of 2 stanchions shall be located on each long wall of the handhole.
2. Arms: Arranged for secure, drop-in attachment in horizontal position at any location on cable stanchions, and capable of being locked in position. Arms shall be available in lengths ranging from 3 inches with 450-lb minimum capacity to 20 inches with 250-lb minimum capacity. Top of arm shall be nominally 4 inches wide, and arm shall have slots along full length for cable ties.
a. Provide a minimum of two (2) 14” long arms per stanchion.
3. Hardware: Stainless Steel Type 316.

G. Fixed Manhole Ladders: Arranged for attachment to roof and floor of manhole. Ladder and mounting brackets and braces shall be fabricated from nonconductive, structural grade, fiberglass-reinforced resin. Fiberglass ladder shall have flame retardant and ultraviolet inhibitor additives. Ladder shall be yellow in color. Ladder shall be designed and fabricated to meet the requirements of OSHA 1910.27. Hardware shall be stainless steel type 316.
1. Ladder shall be installed close to the opening in the manhole roof.

H. Cover Hooks: Heavy duty, designed for lifts 60 lbf and greater. Two required.

I. Warning Sign: Install "Confined Space Hazard" warning sign inside the manhole.

2.5 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Polymer Concrete Handhole:
1. Enclosures, boxes, and covers shall conform to all test provisions of the most current ANSI/SCTE 77 “Specification For Underground Enclosure Integrity” for Tier 22 applications. All covers are required to have the Tier level rating embossed on the surface. In no assembly can the cover design load exceed the design load of the box.
2. Handhole shall be tested by UL to meet the requirements of ANSI/SCTE 77. Handhole shall be UL Listed.
3. Handhole shall have a solid bottom.
4. Handhole design load (including box and cover) shall be 22,500 pounds.
5. Handhole cover shall be secured to the box with stainless steel bolts.
6. Handhole shall be manufactured by Quazite or approved equal. See drawings for dimensions of handhole.

2.6 DUCT SEALING COMPOUND

A. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, and not deteriorous to cable insulation. Capable of adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals. Sealing compound will not flow up to 250 degrees F. Sealing compound will not become brittle at minus 30 degrees F. Duct-Sealing compound shall be O-Z Gedney DUX 1 or DUX 5, or approved equal.

2.7 SOURCE QUALITY CONTROL

A. Test and inspect precast concrete utility structures according to ASTM C 1037.

B. Polymer Concrete Handhole: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
PART 3 - EXECUTION

3.1 DUCT APPLICATION

A. Direct-buried ducts: Duct shall be NEMA TC 2, Type EPC-40-PVC, unless otherwise noted on the drawings.

B. Concrete encased ducts: Duct shall be NEMA TC 2, Type EPC-40-PVC, unless otherwise noted on the drawings.

3.2 EARTHWORK

A. Excavation and Backfill: Do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching.

D. Cut and patch existing pavement in the path of underground ducts and utility structures. Repair existing pavement after underground ducts and utility structures have been constructed/installed. The newly repaired pavement shall match the existing pavement.

E. Remove, re-install and repair as required, existing fences, walls or structures that are in the path of underground ducts and utility structures.

3.3 DUCT INSTALLATION

A. Burial Depth:
   1. Direct buried duct or ductbanks: All direct buried duct or ductbanks shall have a minimum of 24” of cover from the top of the duct or ductbank to finished grade, unless otherwise noted on the drawings.
   2. Concrete encased ducts or ductbanks: See drawings

B. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes or handholes to drain in both directions.

C. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, both horizontally and vertically, at other locations, unless otherwise indicated.

D. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.
E. Provide duct sealing compound where underground ducts and ductbanks stub up at utility poles and where underground ducts and ductbanks enter buildings. Duct sealing compound shall provide a watertight seal inside the ducts and ductbanks.

F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.

G. Pulling Cord: Install 100-lbf- (445-N-) test nylon cord in ducts, including spares.
   1. Provide pulling cord in all unused or spare ducts.

H. Duct Entrances to Manholes and Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.
   1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line.
   2. Grout end bells into structure walls from both sides to provide watertight entrances.

I. Building Wall Penetrations: Install conduit penetrations of building walls as specified in Specification Section "Common Work Results for Electrical."

J. Concrete-Encased Ducts:
   1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
   2. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
   3. Excavate trench bottom to provide firm and uniform support for ducts.
   4. Place and compact bedding course on trench bottoms. Use satisfactory soil, free of particles larger than 1 inch in any direction, as the compact bedding course. Depth of bedding course shall be not less than 6".
   5. Concreting Sequence: Pour each run of envelope between manholes, handholes or other terminations in one continuous operation.
      a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
      b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into concrete on both sides of joint near corners of envelope.
   6. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
7. **Reinforcement:** Reinforce concrete-encased duct banks where indicated on the drawings. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.

8. **Forms:** Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.

9. **Separation:** Provide a minimum of 12” separation between electrical (power or communications) ducts and foreign structures (including, but not limited to, gas, water, sanitary and oil pipes), unless otherwise noted. Provide a minimum of 6” separation between power ducts and communications (including, but not limited to, telephone and cable tv) ducts, unless otherwise noted. Provide a minimum of 3” separation between power ducts and other power ducts, unless otherwise noted. Provide a minimum of 3” separation between communication ducts and other communication ducts, unless otherwise noted.

10. **Stub-Ups:** Use manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Extend concrete encasement throughout the length of the elbow.

11. **Warning Tape:** Bury warning tape above all concrete-encased ducts. Align tape parallel to and within 3 inches of the centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 36 inches. Space additional tapes 12 inches apart, horizontally. Depth of warning tape shall be 12” below finished grade.

K. **Direct-Buried Ducts:**

1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.

2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches between tiers.

3. Excavate trench bottom to provide firm and uniform support for ducts.

4. Place and compact bedding course on trench bottoms. Use satisfactory soil, free of particles larger than 1 inch in any direction, as the compact bedding course. Depth of bedding course shall be not less than 6”.

5. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction.

6. **Separation:** Provide a minimum of 12” separation between electrical (power or communications) ducts and foreign structures (including, but not limited to, gas, water, sanitary and oil pipes), unless otherwise noted. Provide a minimum of 12” separation between power ducts and communications (including, but not limited to, telephone and cable tv) ducts, unless otherwise noted. Provide a minimum of 3” separation between power ducts and other power ducts, unless otherwise noted. Provide a minimum of 3” separation between communication ducts and other communication ducts, unless otherwise noted.
7. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated.

8. Warning Tape: Bury warning tape above all direct buried ducts. Align tape parallel to and within 3 inches of the centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 36 inches. Space additional tapes 12 inches apart, horizontally. Depth of warning tape shall be 12” below finished grade.

9. Concrete encasement at bends and 90 degree elbows: All bends and 90 degree elbows shall be concrete encased with a minimum of 3” thick of 3000 psi concrete at 28 days.

L. Provide underground-line warning tape above all direct buried and concrete encased ducts.

M. Excavation for Utility Trenches:

1. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of ducts and ductbanks.

N. Utility Trench Backfill:

1. Place backfill on subgrades free of mud, frost, snow, or ice.
2. Backfill material shall be free of particles larger than 1 inch in any dimension
3. Carefully compact initial backfill under conduit haunches and compact evenly up on both sides and along the full length of conduit to avoid damage or displacement of conduit.
4. Backfill voids while installing and removing shoring and bracing.
5. Backfill in layers not more than 4 inches for material compacted by hand operated tampers.
6. Compact soil material to not less than the following percentage of maximum dry unit weight according to ASTM D698:
   a. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

O. Underground ducts and ductbanks shall be made watertight.

3.4 INSTALLATION OF PRECAST CONCRETE MANHOLES, HANDHOLES, AND BOXES

A. Precast Concrete Handhole and Manhole Installation:

1. Comply with ASTM C 891, unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, 6” deep minimum, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

B. Elevations:

1. Manhole and Handhole Frame: Set frames flush with finished grade.

C. Manhole and Handhole Access: Circular opening in manhole or handhole roof; sized to match cover size.
1. Install chimney, constructed of precast concrete collars and rings to support frame and cover and to connect cover with manhole or handhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney.

D. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, as required for installation and support of cables and conductors and as indicated.

E. Provide “Confined Space Hazard” sign inside the manhole.

3.5 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, 6” deep minimum, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: Cover surface will be flush with finished floor or finished grade.

D. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts.

2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.

B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.7 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes and handholes, including sump. Remove foreign material.

END OF SECTION 260119
SECTION 260120 - CONDUCTORS AND CABLES

PART 1 - GENERAL

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

1.2 SUMMARY
   A. This Section includes the following:
      1. Building wires and cables rated 600 V and less.
      2. Connectors, splices, and terminations rated 600 V and less.
      3. Sleeves and sleeve seals for cables.

1.3 DEFINITIONS
   A. AWG: American Wire Gauge
   B. KCMIL: Thousand Circular Mil

1.4 SUBMITTALS
   A. Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE
   A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70,
      Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for
      intended use.
   B. Comply with NFPA 70.

1.6 COORDINATION
   A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they
      are constructed.
PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. General Cable Corporation.

B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation:
   1. Comply with NEMA WC 70 for Types THHN/THWN-2. Suitable for operation at 600 volts or less in wet or dry locations.
   2. RHH/RHW-2/USE-2 Conductor:
      a. Listed to UL 44 and UL 854
      b. Suitable for operation at 600 volts or less in wet or dry locations, including direct burial in earth.
      c. Insulation is an abrasion, moisture, heat, and sunlight resistant black cross-linked polyethylene (XLP)
      d. Conductor shall be manufactured by Southwire or approved equal.

2.2 CONNECTORS AND SPLICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. AFC Cable Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

C. 600V Vinyl Insulating Tape: The tape is based on polyvinyl chloride (PVC) and/or its copolymers and has a rubber based, pressure-sensitive adhesive. The tape shall be 7 mils thick, and UL Listed and marked per UL Standard 510 as “Flame Retardant, Cold and Weather Resistant.”

D. Screw-on Pressure Cable Connector: Connector shall be UL Listed. Voltage rating shall be 600 volts for building wire and 1000 volts for signs and fixtures.

E. Mechanical Connector: Connector shall be UL Listed. Connector shall be wrapped with electrical insulating tape in accordance with the NEC and the manufacturer’s requirements.
Connectors shall be dual rated (suitable for use with copper or aluminum conductors), unless otherwise noted.

F. Compression Connector: Connector shall be UL Listed. Connector shall be wrapped with electrical insulating tape in accordance with the NEC and the manufacturer’s requirements. Use compression tool recommended by manufacturer. Connectors shall be dual rated (suitable for use with copper or aluminum conductors), unless otherwise noted.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Service: Copper. Stranded.

B. Feeders: Copper (unless otherwise noted on the drawings). Stranded.

C. Branch Circuits: Copper. Solid for No. 10 AWG and smaller (exception: conductors for vibrating equipment, such as transformers, motors and generators, shall use stranded conductors); stranded for No. 8 AWG and larger.

D. Class 1 and Class 2 Control Wiring: Copper. Stranded.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Aboveground Service Entrance: Type THHN/THWN-2, single conductors in raceway, unless otherwise noted.

B. Aboveground Exposed Feeders: Type THHN/THWN-2, single conductors in raceway, unless otherwise noted.

C. Aboveground Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway, unless otherwise noted.

D. Aboveground Feeders Concealed in partly excavated or crawl spaces and in service tunnels used solely for repairs and maintenance: Type THHN/THWN-2, single conductors in raceway, unless otherwise noted.

E. Aboveground Exposed Branch Circuits: Type THHN/THWN-2, single conductors in raceway, unless otherwise noted.

F. Aboveground Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway, unless otherwise noted.

G. Aboveground Branch Circuits Concealed in partly excavated or crawl spaces and in service tunnels used solely for repairs and maintenance: Type THHN/THWN-2, single conductors in raceway, unless otherwise noted.
H. Aboveground Class 1 and Class 2 Control Wiring: Type THHN/THWN-2, single conductors in raceway unless otherwise noted.


   1. Change from THHN/THWN-2 single conductors in raceway, to RHH/RHW-2/USE-2 single conductors in raceway, at the last junction box or enclosure inside the building.

J. Underground Class 1 and Class 2 Control Wiring: Type RHH/RHW-2/USE-2 single conductors in raceway.

   1. Change from THHN/THWN-2 single conductors in raceway, to RHH/RHW-2/USE-2 single conductors in raceway, at the last junction box or enclosure inside the building.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with the NEC.

B. Comply with the manufacturer’s recommendations and requirements.

C. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

D. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

E. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

F. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

G. Identify and color-code conductors and cables according to Specification Section "Electrical Identification."

H. Do not splice feeders and underground branch circuits unless specifically indicated in the drawings. Cables shall be unspliced between termination points.

I. Provide insulated bushings at the end of each metal clad cable.

J. Use insulating bushings to protect ALL conductors, including conductors smaller than No. 4 AWG. Provide insulated grounding bushings where required by NFPA 70 or the Contract Documents.

K. Spare wires shall be disconnected at both ends and shall be insulated at both ends with wire nuts held in place by electrical insulating tape. For large wire sizes, the spare wires shall be disconnected at both ends and shall be insulated at both ends with double wrapped electrical insulating tape.
CONDUCTORS AND CABLES

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

END OF SECTION 260120
SECTION 260130 - RACEWAYS AND BOXES

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 DEFINITIONS

A. FMC: Flexible metal conduit.
B. LFMC: Liquidtight flexible metal conduit.
C. RNC: Rigid nonmetallic conduit.
D. EMT: Electrical metallic tubing.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Source quality-control test reports.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
3. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. Wheatland Tube Company.
6. Robroy Industries Electrical Products Division

B. Rigid Steel Conduit: ANSI C80.1.

C. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
   1. Comply with NEMA RN 1.
   2. PVC coated, with 40 mil PVC exterior coating and 2 mil urethane interior coating
   3. The PVC Coated steel conduit must be ETL Verified to the Intertek ETL SEMKO High Temperature H20 PVC Coating Adhesion Test Procedure for 200 hours. The conduit must bear the ETL Verified PVC-001 label to signify compliance to the adhesion performance standard.

D. FMC: Zinc-coated steel

E. EMT and Fittings: ANSI C80.3.
   1. Fittings: Compression type.

F. LFMC: Flexible steel conduit with PVC jacket.

G. Fittings for Conduit (Including all Types and Flexible and Liquidtight), and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
   1. Insulating Bushings: Plastic, 105 degree C minimum temperature rating.
   2. Insulated Grounding Bushings: Malleable Iron with plastic liner, 105 degree C minimum temperature rating.
   3. Conduit Bodies, Couplings and fittings for PVC-Coated Steel Conduit:
      a. PVC coated, with 40 mil PVC exterior coating and 2 mil urethane interior coating

2.2 NONMETALLIC CONDUIT AND TUBING

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. AFC Cable Systems, Inc.
   2. Anamet Electrical, Inc.; Anaconda Metal Hose.
   3. CANTEX Inc.
   5. Electri-Flex Co.
   6. Lamson & Sessions; Carlon Electrical Products.
   7. RACO; a Hubbell Company.
   8. Thomas & Betts Corporation.

B. RNC: NEMA TC 2, Type EPC-40-PVC (PVC Schedule 40) and Type EPC-80-PVC (PVC Schedule 80), UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B. RNC shall be sunlight resistant and rated for use with 90 degree C conductors.
2.3 METAL WIREWAYS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.

B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Screw-cover type, unless otherwise noted

E. Finish: ANSI 61 gray polyester powder paint finish inside and out over phosphatized surfaces.

2.4 BOXES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
3. Hoffman.
5. O-Z/Gedney; a unit of General Signal.
6. RACO; a Hubbell Company.
7. Robroy Industries, Inc.; Enclosure Division.
8. Spring City Electrical Manufacturing Company.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, aluminum, Type FD, with gasketed cover.

D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

E. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

2.5 ENCLOSURES AND CABINETS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated on the drawings.
   1. Aboveground, Exposed: Rigid Steel Conduit, unless otherwise noted.
   2. Aboveground, Concealed: Rigid Steel Conduit, unless otherwise noted.
   4. Connection to Vibrating Equipment (Including Transformers, Motors, Pumps, Fans, and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC, unless otherwise noted.
   5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R, unless otherwise noted.

B. Indoors (Except Salt Barn): Apply raceway products as specified below, unless otherwise indicated on the drawings.
   1. Aboveground, Exposed: EMT, unless otherwise noted.
   2. Aboveground, concealed in Ceilings and Interior Walls and Partitions: EMT, unless otherwise noted.
   3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, unless otherwise noted and except as follows:
      a. Damp or wet locations: LFMC
      b. Connection to fire pump motor: LFMC
   4. Damp or Wet Locations: Rigid Steel Conduit, unless otherwise noted.
   5. Where subject to physical damage: Rigid Steel Conduit, unless otherwise noted.
   6. Boxes and Enclosures: NEMA 250, Type 1, unless otherwise noted and except as follows:
      a. Boxes and enclosures related to the fire pump or fire pump controller located inside the fire pump room: NEMA 250, Type 12, unless otherwise noted.
      b. Boxes, Enclosures and Fittings in Hazardous (Classified) Locations: Use UL 886 Listed, Hazardous Location rated boxes, enclosures, fittings and accessories. Boxes and fittings shall be PVC coated (with 40 mil PVC exterior coating and 2 mil urethane interior coating) where PVC Coated Steel Conduit is required.
   7. Conduit Larger than 4-inch trade size: Rigid Steel Conduit
   8. Inside and outside Salt Barn and Lean-To: PVC Coated Ridge Steel Conduit

C. Wireways: All wireways shall be metal, with ANSI 61 gray polyester powder paint finish inside and out over phosphatized surfaces, unless otherwise noted.
D. Minimum Raceway Size: 3/4-inch trade size, unless otherwise noted.

E. Raceway Fittings: Compatible with raceways and suitable for use and location.
   1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

3.2 INSTALLATION

A. Transition from underground PVC conduit or under concrete floor slab PVC conduit to aboveground metal conduit: Change from PVC conduit to Rigid Steel Conduit (or PVC Coated Steel Conduit where required by the RACEWAY APPLICATION in this Specification Section or the drawings) 6” below floor or grade, and continue with Rigid Steel Conduit (or PVC Coated Steel Conduit where required by the RACEWAY APPLICATION in this Specification Section or the drawings) up to the device/equipment or 48” above finished floor/grade (whichever is higher), unless otherwise noted. Beyond the device/equipment or above 48” (whichever is higher), use the raceway specified in the RACEWAY APPLICATION of this Specification Section or the drawings, unless otherwise noted.

B. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

C. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

D. Complete raceway installation before starting conductor installation.

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Raceway Terminations: Use insulating bushings to protect ALL conductors, including conductors smaller than No. 4 AWG. Provide insulated grounding bushings where required by NFPA 70 or the Contract Documents.

G. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

H. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
   1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
   2. Where otherwise required by NFPA 70.

I. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
   1. Use LFMC where required by the Contract Documents.
J. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

K. Raceway shall run parallel or perpendicular to wall and ceiling structures (columns, joists, support beams, etc.) for a neat appearance.

L. All metallic raceways, boxes and enclosures shall be grounded.

M. Provide watertight hubs for all junction boxes and enclosures installed outdoors or in wet locations. Hubs used with NEMA 3R junction boxes and enclosures shall be NEMA 3R or NEMA 4X rated. Hubs used with NEMA 4 or 4X junction boxes and enclosures shall be NEMA 4X rated.

N. Underground raceway shall be made watertight.

3.3 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2. Repair damage to paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260130
SECTION 260410 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

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

1.2 SUMMARY
   A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
      1. Fusible switches.
      2. Nonfusible switches.
      3. Enclosed molded-case circuit breakers.
      4. Enclosures.

1.3 DEFINITIONS
   A. GFCI: Ground-fault circuit interrupter.
   B. GD: General duty.
   C. HD: Heavy duty.
   D. RMS: Root mean square.
   E. SPDT: Single pole, double throw.

1.4 SUBMITTALS
   A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
      1. Enclosure types and details for types other than NEMA 250, Type 1.
      2. Current and voltage ratings.
      4. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
   B. Shop Drawings: Diagram power, signal, and control wiring.
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

C. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
2. Time-current curves, including selectable ranges for each type of circuit breaker.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

1.7 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

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 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 FUSIBLE AND NONFUSIBLE SWITCHES

A. Available Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
4. Square D/Group Schneider.

B. Type HD, Heavy Duty Switch: NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Type GD, General Duty Switch: NEMA KS 1, Type GD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

D. Provisions for padlocks: Fusible and non-fusible switches shall include provisions for being padlocked in the open or closed position.

E. Fusible switches shall be suitable for use with Class R fuses unless otherwise noted and except as follows:
   1. Provide fusible switches with Class J fuses where indicated on the drawings.
   2. Provide fusible switches with Class L or Class T fuses where indicated on the drawings.

F. Fusible switches shall have clips or bolt pads to accommodate specified fuses.

G. Short circuit rating of Type GD Fusible Switches when used with Class R or Class T fuses shall not be less than 100,000A.

H. Short circuit rating of Type HD Fusible Switches when used with Class R, Class J, or Class L fuses shall not be less than 200,000A.

I. Conductor Connectors: Suitable for use with conductor material and sizes.

J. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
   2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
   3. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

2.3 ENCLOSED MOLDED-CASE CIRCUIT BREAKERS

A. Available Manufacturers:
   1. Eaton Corporation; Cutler-Hammer Products.
   2. General Electric Co.; Electrical Distribution & Control Division.
   5. Square D/Group Schneider.

B. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.

C. Provisions for padlocks: Molded-Case Circuit-Breakers shall include provisions for being padlocked in the open or closed position.

1. When the breaker is padlocked in the closed position, the padlock shall not prevent the breaker from tripping due to overcurrent conditions.
2. Enclosed circuit breakers with NEMA 1 Enclosures that are required to be lockable shall have Handle Padlock Attachments.

D. Molded-Case Circuit-Breaker Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical style suitable for number, size, trip ratings, and conductor material.
4. Application Listing: Type HACR for heating, air-conditioning, and refrigerating equipment;
5. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
6. Auxiliary Switch: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

E. Circuit Breaker Short-Circuit Current Rating:

1. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.4 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location. See drawings for NEMA 250 enclosure type.

2.5 IDENTIFICATION

A. Service Equipment Label: Service equipment shall be UL labeled for use as service equipment.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Fusible and Nonfusible Switches shall be Type GD, General Duty Switches, unless otherwise noted and except as follows:
1. Type HD, Heavy Duty Switches shall be provided if ANY of the following conditions apply:
   a. Where the voltage rating of the switch exceeds 240VAC;
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

b. Where Class J fuses are specified;
c. Where NEMA 4X enclosures are specified;
d. Where a key switch, auxiliary contact, or electrical interlock is required;
e. Where the ampere rating of the switch exceeds 600A; OR
f. Where indicated on the drawings.

3.2 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.
C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
D. Provide UL Listed fuse reducers as required

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Specification Section "Electrical Identification."
B. Enclosure Nameplates: Label each enclosure as specified in Specification Section "Electrical Identification."

3.5 ADJUSTING

A. Set field-adjustable circuit-breaker trip ranges.

3.6 CLEANING

A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.
B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION 260410
SECTION 265600 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Exterior luminaires with lamps and ballasts.
   2. Luminaire-mounted photoelectric relays.
   3. Poles and accessories.
   4. Luminaire lowering devices.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. LER: Luminaire efficacy rating.

D. Luminaire: Complete lighting fixture, including ballast housing if provided.

E. Pole: Luminaire support structure, including tower used for large area illumination.

F. Standard: Same definition as "Pole" above.

1.4 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-4-M.

B. Live Load: Single load of 500 lbf (2224 N), distributed as stated in AASHTO LTS-4-M.

C. Ice Load: Load of 3 lbf/sq. ft. (145 Pa), applied as stated in AASHTO LTS-4-M Ice Load Map.

D. Wind Load: Pressure of wind on pole and luminaire and banners and banner arms, calculated and applied as stated in AASHTO LTS-4-M.
1.5 ACTION SUBMITTALS

A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
2. Details of attaching luminaires and accessories.
3. Details of installation and construction.
4. Luminaire materials.
5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.
   a. Testing Agency Certified Data: For indicated luminaires, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
   b. Manufacturer Certified Data: Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
6. Photoelectric relays.
7. Ballasts, including energy-efficiency data.
8. Lamps, including life, output, CCT, CRI, lumens, and energy-efficiency data.
10. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
11. Anchor bolts for poles.
12. Manufactured pole foundations.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
3. Design calculations, certified by a qualified professional engineer, indicating strength of screw foundations and soil conditions on which they are based.
4. Wiring Diagrams: For power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

A. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4-M and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations by a professional engineer.

B. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.

C. Field quality-control reports.
D. Warranty: Sample of special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and poles, luminaire lowering devices to include in emergency, operation, and maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: One for every 100 of each type and rating installed. Furnish at least one of each type.
2. Glass and Plastic Lenses, Covers, and Other Optical Parts: One for every of each type and rating installed. Furnish at least one of each type.
3. Ballasts/LED drivers: One for every 100 of each type and rating installed. Furnish at least one of each type.
4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.9 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.


E. Comply with NFPA 70.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Package aluminum poles for shipping according to ASTM B 660.

B. Store poles on decay-resistant-treated skids at least 12 inches (300 mm) above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

C. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.
1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.

1. Warranty Period for Luminaires: Five years from date of Substantial Completion.
2. Warranty Period for Metal Corrosion: Five years from date of Substantial Completion.
3. Warranty Period for Color Retention: Five years from date of Substantial Completion.
4. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide product indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES

A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

B. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.

E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

G. Exposed Hardware Material: Stainless steel.

H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

J. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
   1. White Surfaces: 85 percent.
   2. Specular Surfaces: 83 percent.
   3. Diffusing Specular Surfaces: 75 percent.

K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

L. Heat sink.

2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

A. Comply with UL 773 or UL 773A.

B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc (16 to 32 lx) and off at 4.5 to 10 fc (48 to 108 lx) with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.
   1. Relay with locking-type receptacle shall comply with ANSI C136.10.
   2. Adjustable window slide for adjusting on-off set points.

2.4 GENERAL REQUIREMENTS FOR POLES AND SUPPORT COMPONENTS

A. Structural Characteristics: Comply with AASHTO LTS-4-M.
   1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in "Structural Analysis Criteria for Pole Selection" Article.
   2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.

B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
   1. Materials: Shall not cause galvanic action at contact points.
   3. Anchor-Bolt Template: Plywood or steel.
D. Handhole: Oval-shaped, with minimum clear opening of 2-1/2 by 5 inches (65 by 130 mm), with cover secured by stainless-steel captive screws.

E. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."

F. Power-Installed Screw Foundations: Factory fabricated by pole manufacturer, with structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole base flange and strength required to support pole, luminaire, and accessories.

G. Breakaway Supports: Frangible breakaway supports, tested by an independent testing agency acceptable to authorities having jurisdiction, according to AASHTO LTS-4-M.

2.5 STEEL POLES

A. Poles: Comply with ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psig (317 MPa); one-piece construction up to 40 feet (12 m) in height with access handhole in pole wall.
   1. Shape: Round, tapered.
   2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

B. Steel Mast Arms: Single-arm type, continuously welded to pole attachment plate. Material and finish same as pole.

C. Brackets for Luminaires: Detachable, cantilever, without underbrace.
   1. Adapter fitting welded to pole, allowing the bracket to be bolted to the pole mounted adapter, then bolted together with galvanized-steel bolts.
   2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire.
   3. Match pole material and finish.

D. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

E. Grounding and Bonding Lugs: Welded 1/2-inch (13-mm) threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

F. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported cable times a 5.0 safety factor.

G. Platform for Lamp and Ballasts/Drivers Servicing: Factory fabricated of steel with finish matching that of pole.

H. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.
I. Galvanized Finish: After fabrication, hot-dip galvanize complying with ASTM A 123/A 123M.

J. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or with SSPC-SP 8, "Pickling."
2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
   a. Color: see lighting schedules on drawings.

2.6 POLE ACCESSORIES

A. Duplex Receptacle: 120 V, 20 A in a weatherproof assembly complying with Section "Wiring Devices" for ground-fault circuit-interrupter type.
   1. Recessed, 12 inches (300 mm) above pole base.
   2. Nonmetallic polycarbonate plastic or reinforced fiberglass, weatherproof in use, cover, color to match pole, that when mounted results in NEMA 250, Type 3R enclosure.
   3. With cord opening.
   4. With lockable hasp and latch that complies with OSHA lockout and tag-out requirements.

B. Base Covers: Manufacturers' standard metal units, arranged to cover pole's mounting bolts and nuts. Finish same as pole.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

A. Install lamps in each luminaire.

B. Fasten luminaire to indicated structural supports.
   1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources.
3.2 POLE INSTALLATION

A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.

B. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified on drawings.

C. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
   1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
   2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
   3. Install base covers unless otherwise indicated.
   4. Use a short piece of 1/2-inch- (13-mm-) diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

3.3 CORROSION PREVENTION

A. Steel Conduits: Comply with Section "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.4 GROUNDING

A. Ground metal poles and support structures according to Section "Grounding and Bonding for Electrical Systems."
   1. Install grounding electrode for each pole unless otherwise indicated.
   2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

B. Ground nonmetallic poles and support structures according to Section "Grounding and Bonding for Electrical Systems."
   1. Install grounding electrode for each pole.
   2. Install grounding conductor and conductor protector.
   3. Ground metallic components of pole accessories and foundations.

3.5 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.
Bowie State University - Car Parking Lot

1. Verify operation of photoelectric controls.

C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 265600
SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Stripping and stockpiling rock.
6. Removing above- and below-grade site improvements.
7. Disconnecting, capping or sealing, and removing site utilities.
8. Temporary erosion and sedimentation control.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for temporary erosion- and sedimentation-control measures.

1.3 DEFINITIONS

A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow.

D. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects larger than 2 inches (50 mm) in diameter; and free of weeds, roots, toxic materials, or other nonsoil materials.

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

G. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at project site.

1.5 MATERIAL OWNERSHIP

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

1.6 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or video recordings.

2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.

B. Topsoil stripping and stockpiling program.

C. Rock stockpiling program.

D. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

E. Burning: Documentation of compliance with burning requirements and permitting of authorities having jurisdiction. Identify location(s) and conditions under which burning will be performed.

1.7 QUALITY ASSURANCE

A. Topsoil Stripping and Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.

B. Rock Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.
1.8 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and 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 Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by ENGINEER.

C. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

D. Utility Locator Service: The Contractor shall be responsible for providing a private utility locator at no additional cost to the owner.

E. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

F. Tree- and Plant-Protection Zones: Protect according to requirements in Section 015639 "Temporary Tree and Plant Protection."

G. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

B. Antirust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer complying with MPI #23 (surface-tolerant, anticorrosive metal primer).

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.
B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed according to requirements in Section 015639 "Temporary Tree and Plant Protection."

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

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

A. Protect trees and plants remaining on-site.

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations.

3.4 EXISTING UTILITIES

A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.
   1. Verify that utilities have been disconnected and capped before proceeding with site clearing.

B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed.
   1. Arrange with utility companies to shut off indicated utilities.
   2. Owner will arrange to shut off indicated utilities when requested by Contractor.

C. Locate, identify, and disconnect utilities indicated to be abandoned in place.

D. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
1. Notify ENGINEER not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without ENGINEER's written permission.

E. Excavate for and remove underground utilities indicated to be removed.

F. Removal of underground utilities is included in earthwork sections; in applicable fire suppression, plumbing, HVAC, electrical, communications, electronic safety and security, and utilities sections; and in Section 024116 "Structure Demolition".

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
   1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
   2. Grind down stumps and remove roots larger than 2 inches diameter, obstructions, and debris to a depth of 18 inches below exposed subgrade.
   3. Use only hand methods or air spade for grubbing within protection zones.
   4. Chip removed tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
   1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches (200 mm), 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 depth of 6 inches in a manner to prevent intermingling with underlying subsoil or other waste materials.
   1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects larger than 2 inches (50 mm) in diameter; trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
   1. Limit height of topsoil stockpiles to 72 inches.
   2. Do not stockpile topsoil within protection zones.
   3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
   4. Stockpile surplus topsoil to allow for respreading deeper topsoil.
3.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

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

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

B. Burning tree, shrub, and other vegetation waste is permitted according to burning requirements and permitting of authorities having jurisdiction. Control such burning to produce the least smoke or air pollutants and minimum annoyance to surrounding properties. Burning of other waste and debris is prohibited.

C. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials, and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000
SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Excavating and filling for rough grading the Site.
   2. Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses and plants.
   4. Subbase course and base course for asphalt paving.
   5. Excavating and backfilling trenches for utilities.

B. Related Requirements:
   1. Section 329300 "Plants" for finish grading in planting areas and tree and shrub pit excavation and planting.

C. References:
   1. A Geotechnical Investigation was previously conducted for the project site for the purposes of aiding in the preparation of design documents. Geotechnical Investigation Report dated October 18, 2018 prepared by Findling, Inc is included as an attachment to this Section for Contractor’s informational purposes during bidding only.

1.3 UNIT PRICES

A. Work of this Section is affected by unit prices for earth moving specified in Section 012200 "Unit Prices.". Unit Prices shall only apply for unsuitable soil undercut established under Section 012100 “Allowances”, for unsuitably soils in the parking lot area that fail subgrade proof-roll as described in paragraph 3.7 and as directed by the Inspection Agency.

B. Quantity allowances for earth moving are included in Section 012100 "Allowances.

1.4 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
   1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
   2. Final Backfill: Backfill placed over initial backfill to fill a trench.
B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
   1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by ENGINEER. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
   2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
   3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by ENGINEER. Unauthorized excavation, as well as remedial work directed by ENGINEER, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by a geotechnical testing agency, according to ASTM D 1586.

I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

J. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

K. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

L. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct preexcavation conference at Project site.
   1. Review methods and procedures related to earthmoving, including, but not limited to, the following:
      a. Personnel and equipment needed to make progress and avoid delays.
      b. Coordination of Work with utility locator service.
c. Coordination of Work and equipment movement with the locations of tree- and plant-protection zones.
d. Extent of trenching by hand or with air spade.
e. Field quality control.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:
   1. Geotextiles.
   2. Controlled low-strength material, including design mixture.
   3. Warning tapes.

B. Samples for Verification: For the following products, in sizes indicated below:
   2. Warning Tape: 12 inches long; of each color.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:
   1. Classification according to ASTM D 2487.
   2. Laboratory compaction curve according to ASTM D 1557.

1.8 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

1.9 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving 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 Owner or authorities having jurisdiction.

B. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth-moving operations.

C. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified are in place.
D. The following practices are prohibited within protection zones:

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

E. Do not direct vehicle or equipment exhaust towards protection zones.

F. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, SM and ML according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

1. Liquid Limit: <40.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 294/D 2940M 0; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
H. Drainage Course: Narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and zero to 5 percent passing a No. 8 sieve.

I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and zero to 5 percent passing a No. 4 sieve.

J. Sand: ASTM C 33/C 33M; fine aggregate.

K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 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. Apparent Opening Size: No. 70 sieve, maximum; ASTM D 4751.
3. Permittivity: 0.1 per second, minimum; ASTM D 4491.
4. 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. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
3. Permittivity: 0.02 per second, minimum; ASTM D 4491.
4. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.3 CONTROLLED LOW-STRENGTH MATERIAL

A. Controlled Low-Strength Material: Self-compacting, low-density, flowable concrete material produced from the following:

1. Portland Cement: ASTM C 150/C 150M, Type I or Type II.
2. Fly Ash: ASTM C 618, Class C or F.
4. Foaming Agent: ASTM C 869/C 869M.
5. Water: ASTM C 94/C 94M.

B. Produce low-density, controlled low-strength material with the following physical properties:
1. As-Cast Unit Weight: 36 to 42 lb/cu. ft. at point of placement, when tested according to ASTM C 138/C 138M.
2. Compressive Strength: 80 psi, when tested according to ASTM C 495/C 495M.

C. Produce conventional-weight, controlled low-strength material with 80-psi compressive strength when tested according to ASTM C 495/C 495M.

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 wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:

2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.

B. Protect and maintain erosion and sedimentation controls during earth-moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

B. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

3.5 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.6 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: 12 inches each side of pipe or conduit.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. For pipes and conduit less than 6 inches in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.

2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
3. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.

4. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.

E. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.

3.7 SUBGRADE INSPECTION

A. Notify Testing Agency when excavations have reached required subgrade.

B. If Testing Agency determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade below the pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.

2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by ENGINEER, and replace with compacted backfill or engineered fill as directed.

3. The approved subgrade shall then be scarified and moisture conditioned to within 3 percent of the soil’s optimum moisture content and re-compacted.

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by ENGINEER, without additional compensation.

3.8 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by ENGINEER.
1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by ENGINEER.

3.9 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.10 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring, bracing, and sheeting.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.11 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Roadways: Provide 4-inch thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase course. Concrete is specified in Section 321313 "Concrete Paving."

D. Backfill voids with satisfactory soil while removing shoring and bracing.

E. Initial Backfill:

1. Soil Backfill: Place and compact initial backfill of subbase material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.

   a. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
2. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the pipe or conduit. Coordinate backfilling with utilities testing.

F. Final Backfill:

1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.
2. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.

G. Warning Tape: Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.12 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material. Unsuitable soils undercut below pavements, use engineered fill.
3. Under steps and ramps, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.13 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.14 COMPACATION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.
C. Compact soil materials to not less than the following percentages of modified Proctor maximum dry density according to ASTM D 1557:

1. Under vehicular pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill material at 98 percent.
2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 97 percent.
3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
4. For utility trenches, compact each layer of initial and final backfill soil material at 90 percent.

3.15 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus 1 inch.
3. Pavements: Plus or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.16 SUBSURFACE DRAINAGE

A. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches of filter material, placed in compacted layers 6 inches thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.

1. Compact each filter material layer with a minimum of two passes of a plate-type vibratory compactor.

B. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
1. Compact each filter material layer with a minimum of two passes of a plate-type vibratory compactor.
2. Place and compact impervious fill over drainage backfill in 6-inch-thick compacted layers to final subgrade.

3.17 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS
A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.
B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:
   1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
   2. Place base course material over subbase course under hot-mix asphalt pavement.
   3. Shape subbase course and base course to required crown elevations and cross-slope grades.
   4. Place subbase course and base course 6 inches or less in compacted thickness in a single layer.
   5. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
   6. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 98 percent of maximum dry unit weight according to ASTM D 1557.

3.18 FIELD QUALITY CONTROL
A. Testing Agency: The Contractor shall engage a qualified geotechnical engineering testing agency to perform tests and inspections at no additional cost to the Owner.
B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by ENGINEER.
D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2937, and ASTM D 6938, as applicable. Tests will be performed at the following locations and frequencies:
   1. Paved Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area or building slab but in no case fewer than three tests.
   2. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length but no fewer than two tests.
E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.19 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by ENGINEER; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.20 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by ENGINEER.

1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

3.21 ATTACHMENT (on following pages)

A. Geotechnical Investigation Report dated October 18, 2018 prepared by Findling, Inc.
October 18, 2018

Whitney Bailey Cox & Magnani, LLC
300 East Joppa Road, Suite 200
Baltimore, Maryland 21286

Attention: Mr. Randall Hughes, AICP, RLA, LEED AP
Vice President, civil Engineering-Site and Utilities

Re: Geotechnical Investigation Report
Proposed Parking Area and SWM Facility
Bowie State University
Bowie, Maryland 20715
Findling Project No. 16-1037-01

Dear Mr. Hughes:

Findling, Inc. is pleased to submit this report containing the results of the subsurface investigation for the proposed Parking Area and SWM Facility at the above referenced site. The work described in this report was performed in accordance with our proposal dated December 20, 2017.

We wish to advise you that we will store the soil samples obtained from the soil test borings for a period of thirty (30) days from the date of this letter, during which time they will be available for inspection. After that time the samples will be discarded, unless other disposition is requested.

We appreciate the opportunity to be of service to you on this project. If you have any questions, please call us.

Sincerely,

FINDLING, INC.

Jiregna Yadeta, P.E.
Geotechnical Engineer
TABLE OF CONTENTS

1.0 INTRODUCTION ...................................................................................................... 1
2.0 PROJECT DESCRIPTION......................................................................................... 1
3.0 PURPOSE AND SCOPE ....................................................................................... 1
4.0 SUBSURFACE EXPLORATION .............................................................................. 2
   4.1 Field Investigation ............................................................................................ 2
   4.2 Soil Test Borings .............................................................................................. 2
   4.4 Infiltration Testing ........................................................................................... 3
   4.5 Laboratory Testing .......................................................................................... 3
5.0 SUBSURFACE CONDITIONS ................................................................................. 3
   5.1 Site Geology .................................................................................................... 4
   5.2 Soil Conditions ............................................................................................... 4
   5.3 Groundwater .................................................................................................. 4
6.0 DESIGN CONSIDERATIONS .................................................................................. 5
   6.1 Storm Water Management (SWM) Facilities ...................................................... 5
   6.2 Pavement Considerations ............................................................................... 6
      6.2.1 Site Preparation ......................................................................................... 6
      6.2.2 Construction Dewatering ......................................................................... 7
      6.2.3 Pavement Design ..................................................................................... 7
7.0 ENVIRONMENTAL CONSIDERATIONS .............................................................. 9
8.0 REMARKS ............................................................................................................. 9

Appendix
1.0 INTRODUCTION

This report presents the results of the subsurface investigation conducted for the proposed parking Area and Storm Water Management Facility, located at Bowie State University Campus in Bowie, Maryland (see Figure 1: Site Vicinity Map, in the Appendix). This investigation was conducted for WBCM and was authorized by them.

2.0 PROJECT DESCRIPTION

Based on the information provided to us, the proposed project consists of the construction of a parking lot in the grass-area in the northern portion of the university campus. The proposed parking area is anticipated to have 400 parking spaces. The proposed construction also includes construction of storm water management facilities to the north and south of the proposed parking lot as shown on Figure 3: Boring Location Plan in the appendix.

The site grade gently slopes up from north to south and ground surface elevation ranges from El 105± to 120±. The proposed parking area in most part is currently covered with grass.

3.0 PURPOSE AND SCOPE

The purpose of this study was to determine the subsurface conditions in the vicinity of the proposed construction and to evaluate those conditions and prepare recommendations with respect to the geotechnical aspects for the proposed construction.

The evaluations and recommendations presented in subsequent sections of this report were based on our understanding of the proposed construction and on the general subsurface conditions indicated by a series of borings. Should the project characteristics be altered from those discussed or should different subsurface conditions be encountered during construction, this office should be consulted, as the evaluations and recommendations presented herein may no longer be valid.
4.0 SUBSURFACE EXPLORATION

4.1 Field Investigation

The field investigation included drilling a total of Sixteen (16) test borings as shown below

<table>
<thead>
<tr>
<th>Boring ID</th>
<th>Quantity</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-1 thru B-5</td>
<td>5</td>
<td>Parking Area</td>
</tr>
<tr>
<td>SWM-1 thru SWM-11</td>
<td>11</td>
<td>SWM Area</td>
</tr>
</tbody>
</table>

Five (5) test borings (B-1 through B-5) were drilled in the area of the proposed parking area. Eleven (11) test borings (SWM-1 thru SWM-11) were drilled in the area of the Storm Water Management Located to the North and South of the proposed Parking area respectively. Boring depths ranged from 10-feet to 12-feet below existing grade. The locations of the soil test borings are shown on Figure 3: Boring Location Plan, in the Appendix. The borings were staked in the field by a representative of WBCM. An offset hole was drilled and infiltration pipes were installed at all infiltration test borings locations to perform infiltration tests. The borings were drilled using an ATV-mounted CME Track 45 drill rig (using automatic hammer) to obtain SPT samples. All the test borings were monitored for groundwater level during the drilling operations and after 24hrs of completion of the drilling operation and then the borings were backfilled.

4.2 Soil Test Borings

The borings were advanced using hollow-stem augers and soil samples were recovered from the borings at continuous 2-ft intervals by driving a 1 3/8-inch ID (2-inch OD) split-spoon sampler in accordance with ASTM D-1586 specifications. The sampler was first seated about 6-inches to penetrate through the loose cuttings and then driven an additional 1-foot with blows of a 140-pound hammer falling 30-inches. The number of hammer blows required to drive the sampler the final foot is typically designated as the Standard Penetration Resistance (N) value. The penetration resistance is an index of the soil’s strength, density and behavior under applied loads.

Soils obtained from the sampling device were sealed in glass sample jars and transported to our soils testing laboratory. The recovered soil samples were inspected and classified by a Geotechnical Engineer using the Unified Soil Classification System (USCS). A description of the soils and conditions encountered at each test boring location are presented on the Boring Logs and are included in the Appendix.
4.4 Infiltration Testing

Infiltration tests were performed at all the storm water management test borings, in an offset hole that was drilled to a depth of 3-feet to 5-feet below existing ground surface. A 5-inch diameter PVC casing was installed and the inside of the casings was cleaned out in preparation for infiltration tests. Infiltration tests were performed after a period of presoak of 24 hours, for 4 consecutive hours. Upon completion of the tests, the casings were removed and the boreholes were backfilled. The soil conditions encountered in the test borings are summarized on the attached Boring Logs, which are included in the Appendix. The results of Infiltration tests are summarized in the appendix and discussed in the following report section.

4.5 Laboratory Testing

Soil samples recovered from the field explorations were transported to our soil laboratory and selected soil samples were subjected to various testing to determine additional engineering characteristics of the existing on-site soils. The laboratory tests that were conducted on selected soil samples included natural moisture content tests, Atterberg limits, sieve analysis, and hydrometer tests. In addition, Proctor compaction tests and CBR tests were performed on selected bulk bag samples from the pavement borings to assist in pavement design. All tests were performed in general accordance with ASTM procedures. The results of these tests are summarized on Table-2 and included in the Appendix.

5.0 SUBSURFACE CONDITIONS

An Historical topographic map of the proposed construction area of 1894 (See in the appendix) shows that the proposed construction area used to be a beginning of a stream. The outer bank elevation of the stream elevation is estimated to be at El 100±. The existing elevation of the proposed construction area rages from 105± to 120±. Therefore, fill soil material in the range of 5-feet to 15-feet is anticipated in the area.

The Boring Logs included in the Appendix contain details related to the subsurface conditions encountered at the test boring locations. It should be noted that stratification lines shown on the Boring Logs represent approximate transitions between material types. Strata changes can occur gradually or at different levels than those shown on the Boring Logs that depict conditions at the specific indicated locations and depths at the time of our subsurface exploration program. Groundwater levels are variable and are influenced by the existing soil conditions, seasonal and climatic changes.
5.1 Site Geology

Geologically, the site lies in the Coastal Plain Region. The on-site materials consist of interbedded Sand, Gravel and SILT that were deposited by stream erosion. As shown on Figure 4: Site Geology Map, in the Appendix, the soils at the site belong to Terrace deposit that consist predominantly of Sand, Gravel and Silt.

5.2 Soil Conditions

As indicated previously, details of subsurface conditions disclosed by the borings are contained on the individual Boring Logs. The borings were drilled from the existing ground surface. The test borings encountered 4-inches to 12-inches of topsoil.

Stratum 1: FILL (CLAY, SILT and Silty SAND)

Beneath the surficial topsoil, FILL materials consisting of Silty SAND, Clayey SAND, and SILT and Organics were encountered. This stratum extended to depths ranging from 4.0-feet to 10-feet below existing grade. This stratum was generally noted to be in a very loose to medium dense condition with Standard Penetration Resistance (SPT) N-value ranging from 2 blows/foot to 22 blows/foot. The higher blow counts are due to rock fragments within the soil matrix.

Stratum 2: Natural Soil (SILT and Silty SAND)

Below the Fill (Stratum-I), soft to medium stiff natural soils predominantly consisting of SILT (ML) and loose to dense Silty SAND (SM) having various percentage of Clay and Gravel is encountered to the maximum depth explored (i.e., 10 feet to 12 feet below existing grade). The SPT N-values of this stratum ranged from 6 blows per foot to 42 blows per foot.

5.3 Groundwater

Groundwater levels were noted in most of the borings during the drilling operations and after 24hrs following the completion of the drilling operations. Groundwater was encountered at most of the locations except at boring locations, B-1, SWM-9, SWM-10 and SWM-11 within the depths explored (i.e., 10.0-feet to 12.0-feet below existing grade) at the time of our field investigation. Summary of groundwater data recorded during our exploration is presented in Table-1: Summary of boring data, in the appendix.

Fluctuations of water table or the development of a perched water level at shallower depths above less permeable (such as Clay layers) may occur depending upon the amount of precipitation and water runoff to the site during wet season.
6.0 DESIGN CONSIDERATIONS

The evaluations and recommendations presented in subsequent sections of this report were based on our understanding of the proposed construction and on the general subsurface conditions indicated by the subsurface exploration program. Should the project characteristics be altered significantly from those discussed or should different subsurface conditions be encountered during construction, our office should be consulted, as the evaluations and recommendations presented herein may no longer be valid.

The subsurface conditions encountered at the test borings along with the proposed construction activity and the pertinent design parameters at those locations are summarized in the following report section.

6.1 Storm Water Management (SWM) Facilities

Borings SWM-1 thru SWM-11 were drilled at the area of the storm water management facility located in the northern and southern portions of the proposed parking area. The borings were drilled to depths ranging from 10 feet to 12 feet below existing grade. In-situ infiltration tests were performed at depths ranging from 2.5-feet to 5-feet in offset boreholes at these locations.

The results of the infiltration tests are summarized below:

<table>
<thead>
<tr>
<th>Boring No.</th>
<th>*Existing Grade (El)</th>
<th>Test Depth (ft)</th>
<th>Test Elev. (ft)</th>
<th>Soil Type</th>
<th>In-situ Infiltration Test (in/hr)</th>
<th>Groundwater Level, Depth, ft/ (Elev.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWM-1</td>
<td>108.2</td>
<td>2.5</td>
<td>105.7</td>
<td>Silty CLAY (CL)</td>
<td>2.9</td>
<td>3.0/(105.2)</td>
</tr>
<tr>
<td>SWM-2</td>
<td>105.7</td>
<td>3.0</td>
<td>102.7</td>
<td>Silty CLAY (CL)</td>
<td>1.9</td>
<td>2.0/(103.7)</td>
</tr>
<tr>
<td>SWM-3</td>
<td>103.0</td>
<td>3.0</td>
<td>100.0</td>
<td>Clayey SAND (SC)</td>
<td>0.0</td>
<td>0.0/(103.0)</td>
</tr>
<tr>
<td>SWM-4</td>
<td>107.5</td>
<td>2.5</td>
<td>105.0</td>
<td>Silty CLAY (CL)</td>
<td>0.0</td>
<td>4.0/(103.5)</td>
</tr>
<tr>
<td>SWM-5</td>
<td>106.0</td>
<td>3.0</td>
<td>103.0</td>
<td>Silty SAND (SM)</td>
<td>0.0</td>
<td>3.9/(102.1)</td>
</tr>
<tr>
<td>SWM-6</td>
<td>107.5</td>
<td>4.0</td>
<td>103.5</td>
<td>SAND with Silt (SP-SM)</td>
<td>70.0</td>
<td>Dry</td>
</tr>
<tr>
<td>SWM-7</td>
<td>114.0</td>
<td>4.0</td>
<td>110.0</td>
<td>SAND with Silt (SP-SM)</td>
<td>8.5</td>
<td>Dry</td>
</tr>
<tr>
<td>SWM-8</td>
<td>111.3</td>
<td>4.0</td>
<td>107.3</td>
<td>Silty SAND (SM)</td>
<td>0.0</td>
<td>7.1/(104.2)</td>
</tr>
<tr>
<td>SWM-9</td>
<td>119.0</td>
<td>5.0</td>
<td>114.0</td>
<td>Silty SAND (SM)</td>
<td>45.5</td>
<td>Dry</td>
</tr>
<tr>
<td>SWM-10</td>
<td>117.4</td>
<td>5.0</td>
<td>112.4</td>
<td>SAND with Silt (SP-SM)</td>
<td>41.4</td>
<td>Dry</td>
</tr>
<tr>
<td>SWM-11</td>
<td>117.6</td>
<td>5.0</td>
<td>112.6</td>
<td>SAND with Silt (SP-SM)</td>
<td>21.9</td>
<td>Dry</td>
</tr>
</tbody>
</table>

*Ground elevation is adopted from plan provided by WBCM
6.2 Pavement Considerations

6.2.1 Site Preparation

Subgrade Preparation

Site preparation will consist of removal of any topsoil in the area of the proposed parking spaces. All existing utilities, if there are any that may interfere with the proposed grading scheme should be removed and the utility trenches should be backfilled with compacted select fill. Stripping operations should be performed in a manner consistent with good erosion and sediment control practices.

Cut Areas

Based on the proposed plans provided to us, cuts of about 2± feet to 3± feet are anticipated in the South, East and Southwestern sections of the proposed Parking area and stormwater management facilities. The soil test borings drilled near the cut areas of the proposed construction such as B-1, B-4, B-5 SWM-10 and SWM-11 generally indicated that the material near the existing ground surface consist of fill and natural soils mainly of Silty SAND and Clayey SAND with little percentage of Gravel. In general, these materials can be excavated using conventional earth moving equipment. However, due to the variable nature of the fill materials, any hard layers or non-soil fragments that may be encountered within the fill stratum may require special equipment, such as hoe-ram or heavy excavator for excavating them.

Fill Areas

As discussed previously, in order to establish the proposed grades for the parking area generally fills of about 3-feet to 5-feet are required. Fill requirements are mainly in the northern and northwestern areas of the proposed parking spaces. Borings drilled in these fill areas of the proposed parking spaces such as B-2 and B-3 consists of Fill soils at the surface. Fill soil in this area ranged from 1-feet to 5-feet below existing grade. Interbedded natural soil predominantly consisted of SILT and Silty SAND underlay the fill stratum. The depth of the near surface fill (silty SAND) soils varies with location and ranged from 5-feet to 6-feet from existing ground surface. If proofrolling operations indicate relatively soft soils at the surface, then those soft soils should be undercut and replaced with selected fill before placement of fill soils. The depth of undercut is typically expected to be less than 2 feet.

Proofrolling:

Following removal of topsoil and any unsuitable existing fill material and before the backfilling operations at the fill area of the proposed construction, the subgrade should be...
thoroughly proofrolled under the observation of a qualified geotechnical engineer. Proofrolling should be performed with a heavily loaded, rubber-tired piece of construction equipment, such as a fully loaded tandem-axle dump truck, to detect any soft, loose or otherwise unstable deposits. Any unstable soils should be removed and replaced with structural compacted fill.

The approved subgrade should then be scarified and moisture conditioned to within 3 percent of the soil’s optimum moisture content and re-compacted. Excavations and low areas can then be raised to the proposed grades with structural compacted fill that is selected, placed and compacted in accordance with project specifications.

Site preparation, placement and compaction of fill should be performed under engineering-controlled conditions in accordance with project specifications and approved by a qualified geotechnical engineer.

6.2.2 Construction Dewatering

At the time of our field investigation, groundwater was encountered in the test borings B-2, B-3 and B-4 drilled in the area of the proposed parking area at 5± feet below existing grade. It should be noted that groundwater levels could fluctuate by up to about 3 feet with changes in seasonal conditions. Therefore, depending upon the season, excavation depth elevation and amount of precipitation, water may be encountered at a shallower depth which will require dewatering during construction. Therefore, provisions should be made in the project specifications for dewatering.

6.2.3 Pavement Design

Automobile Parking area

Detail regarding the proposed traffic volume were not available. Therefore, we have assumed the following traffic condition in the design.

- 400 parking spaces to park automobile vehicles
- 1% of which is estimated to be heavy trucks
- 6-days a weeks and 52 weeks per year

The above traffic information was used in computing the Equivalent Single Axle Load of \(1.15 \times 10^6\). Borings drilled in the area of the proposed parking area indicated that the pavement subgrade consists of Fill material predominantly consisting of Lean CLAY (CL) and Clayey SAND (SC). Based on the laboratory test results of on-site soils, a
design CBR value of 4 was used in the design of pavements. The following asphalt pavement section is based on a CBR value of 4 and the above assumed traffic condition.

- **1.5" Surface Course (HMA Superpave for Surface, 9.5 mm, PG 64-22)**
- **4" Binder Course (HMA Superpave for Surface, 19 mm, PG 64-22)**
- **8" Graded Aggregate Base (GAB)**
- **Firm Compacted Subgrade (With a minimum Design CBR of 4)**

The symbols in parenthesis represent recommended material types in accordance with Maryland State Highway Administration Superpave specifications.

The top 1 foot of the subgrade should be compacted to 98% of modified Proctor maximum dry density (ASTM D-1557). The subgrade materials should be tested to verify that they provide adequate support for the design pavement section.

On most projects, there is a significant time lag between initial grading and a point when the contractor is ready to place the pavement section. Environmental conditions and construction traffic often disturb the subgrade soils. Provisions should be made in the construction specifications for the restoration of the subgrade to a stable condition prior to the placement of the pavement section by the contractor at no additional cost to the owner.
7.0 ENVIRONMENTAL CONSIDERATIONS

The scope of this work did not include an environmental investigation at the site. Health and Safety issues, if any, should be determined by others.

8.0 REMARKS

This report has been prepared to aid in the evaluation of the site for the construction of the proposed Parking Area and Storm Water Management Facility located at Bowie State University, in Bowie, Maryland. It is considered that adequate recommendations have been provided to serve as a basis for design and preparation of plans and specifications. This report does not contain environmental considerations for the proposed construction.

These analyses and recommendations are based on information made available to us at the time of our investigation and the actual conditions encountered at the test boring locations at that time. General assumptions have been made that the limited exploratory test borings represent the site conditions in relation to the area and depths of the borings. It should be noted, however, that the actual subsurface conditions between the test boring locations might vary from the conditions indicated on the appended test boring logs. Should the actual conditions encountered during construction differ significantly from those indicated by the test boring logs, we should be notified immediately so that the analyses and recommendations can be reviewed and/or revised as necessary.
APPENDIX-1

Figure 1: Site Vicinity Map
Figure 2: Project Location Map
Figure 3: Boring Location Plan
Figure 4: Site Geology

Table 1: Summary of Boring Data
Table 2: Summary of Laboratory Test Results

Results Gradation Curve
Proctor Compaction Curve
CBR Results

Summary of Infiltration Test Results

Boring Logs

Historical Topographic map
ALLUVIUM -- Interbedded sand, silt-clay, and subordinate gravel. Light- to dark-gray, tan, or brown, weathers pale-gray, yellow, or brown.

Alluvium includes very heterogeneous, commonly poorly stratified sediments, with muddy sand and silt the dominant lithology. Organic matter, including leaves, branches, and logs, is a common component. Thin peats occur in places. Dark gray organic muds are prevalent in tidal marsh areas. This unit underlies the channels and flanking valley floors of all major streams and many minor ones in the County. Much of this sediment is soft and water-saturated due to perennially high water tables. The composition of the alluvium in any given stream valley reflects the source sediments; thus, alluvial sand contains considerable glauconite where the source is the Aquia, Nanjemoy, or Severn Formations. Small areas of tidal marsh are found bordering the Patuxent and Potomac Rivers. Alluvial sediment thickness ranges from less than 5 feet (1.5 m) to as much as 40 feet (12.2 m), although the average is closer to 15 feet (4.6 m). Sediments mapped under this heading are geologically young, deposited mostly within the past 10,000 years.

TERRACE DEPOSITS -- Interbedded sand, gravel, and silty-clay. Typically tan, brown, or shades of gray, weathers to yellow, orange, or brown hues, commonly limonite.

Included under Terrace deposits are heterogeneous lithologies such as medium to coarse sand, pebbly sand, and subordinate silt-clay. These sediments are contained in a series of disjunct bodies flanking the major streams in Prince Georges County, reaching as high as 160 feet in elevation across some portions of the county, but declining to near sea level along the Patuxent River. A few such deposits are as thick as 50 feet (15.2 m), but the average is much less. Bedding within these deposits is mostly lenticular, but ranges to massive and unstructured. The Terrace deposits are the product of stream erosion during the early Quaternary, and are now isolated on the valley walls above the modern floodplain by renewed downcutting. Major terraces are associated with Western Branch, Poochaway Creek, and Magnetawas Creek, as well as the Potomac and Patuxent Rivers. Deposits flanking the Patuxent River tend to be more laterally extensive than those along the smaller watercourses, averaging 20 to 25 feet (6.1 to 7.6 m) in thickness, and have been utilized as a source of construction sand and gravel in the past.

UPLAND DEPOSITS -- Sand, pebbly sand, and gravel, capped by sandy pebbly loam in places. Pale-gray, tan, or buff in color; weathering to yellow, orange, and shades of brown.

The Upland deposits (or Brandywine Formation of earlier workers) consist largely of poorly sorted, medium to coarse sand interbedded with pebbly sand and medium to coarse gravel. The sand is predominantly quartz, and the pebbles quartzite, sandstone, and chert. The basal beds of the deposit include scattered boulders ranging to several feet in diameter. Bedding is chiefly lenticular, and cross-bedded to massive. Where least dissected, the uppermost portion of the deposit consists of as much as 15 feet (4.6 m) of compact yellowish to reddish-brown pebbly loam. Total thickness of the unit reaches a maximum of 40 feet (12.2 m). The Upland deposits are fluvial sediments, presumably laid down by the ancestral Potomac River as it swept southward across southern Maryland in late Miocene and Pliocene time (McCant, 1989a, 1989b).

NOTE: FOR ILLUSTRATION PURPOSES ONLY.
Table 1: Summary of Boring Data

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Note: * Estimated from Site Plan provided by Client
** Water table elevation could fluctuate due to seasonal conditions
NE = Not Encountered
### Summary of Laboratory Test Results

**Bowie State University Parking Area & SWM Facility**  
**Prince George's County, Maryland**  
**Findling Project No.: 16-1037-01**

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<th>Natural Moisture Content, %</th>
<th>Atterberg Limits</th>
<th>Grain Size Distribution</th>
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**Note:** NV = Non Viscous, NP = Non Plastic  
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Note: NV = Non Viscous, NP = Non Plastic
## Summary of Laboratory Test Results

Bowie State University Parking Area & SWM Facility  
Prince George's County, Maryland  
Findling Project No.: 16-1037-01

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<td>S-4</td>
<td>6.0 - 8.0</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S-5</td>
<td>8.0 - 10.0</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SWM-11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S-1</td>
<td>0.0 - 2.0</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S-2</td>
<td>2.0 - 4.0</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S-3</td>
<td>4.0 - 6.0</td>
<td>0.0</td>
<td>NV</td>
<td>NP</td>
<td>NP</td>
<td>18.0</td>
</tr>
<tr>
<td>S-4</td>
<td>6.0 - 8.0</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S-5</td>
<td>8.0 - 10.0</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: NV = Non Viscous, NP = Non Plastic
Particle Size Distribution Report

Material Description

USCS: AASHTO

Yellowish orange

Project No.: 16-1037-01  Client: WBCM
Project: Bowie State University Parking Lot
Remarks: Moisture content = 2.7%

Source of Sample: B-1  Depth: 4.0 - 6.0'  Sample Number: S-3

Findling, Inc.
Baltimore, Maryland
Particle Size Distribution Report

<table>
<thead>
<tr>
<th>Grain Size (%)</th>
<th>% +3&quot; Coarse</th>
<th>% Gravel Fine</th>
<th>% Sand Coarse</th>
<th>% Sand Medium</th>
<th>% Sand Fine</th>
<th>% Fines Silt</th>
<th>% Fines Clay</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>0.0</td>
<td>6.0</td>
<td>4.0</td>
<td>7.9</td>
<td>23.9</td>
<td>58.2</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Material Description</th>
<th>USCS</th>
<th>AASHTO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Olive grey</td>
<td>CL</td>
<td>A-4(2)</td>
</tr>
</tbody>
</table>

Project No. 16-1037-01  Client: WBCM  Remarks: Moisture content = 12.4%
Project: Bowie State University Parking Lot  
Source of Sample: B-2  Depth: 1.0' - 5.0'  Sample Number: Bulk  
Findling, Inc.  Baltimore, Maryland  Figure
Material Description | USCS  | AASHTO |
---|---|---|
Light brown | | |

Project No. | 16-1037-01 | Client: | WBCM |
Project: | Bowie State University Parking Lot | Remarks: | Moisture content = 8.9% |
Source of Sample: | B-3 | Depth: | 4.0' - 6.0' |
Sample Number: | S-3 | Findling, Inc. | |
Baltimore, Maryland | Figure |
Particle Size Distribution Report

Material Description: Light brown Clayey SAND with Gravel

<table>
<thead>
<tr>
<th>% +3”</th>
<th>% Gravel</th>
<th>% Sand</th>
<th>% Fines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coarse</td>
<td>Fine</td>
<td>Coarse</td>
</tr>
<tr>
<td>○</td>
<td>0.0</td>
<td>0.0</td>
<td>25.3</td>
</tr>
<tr>
<td>□</td>
<td>LL</td>
<td>PL</td>
<td>D85</td>
</tr>
<tr>
<td>○</td>
<td>20</td>
<td>12</td>
<td>8.7201</td>
</tr>
</tbody>
</table>

Material Description

○ Light brown Clayey SAND with Gravel

USCS: SC
AASHTO: A-2-4(0)

Project No.: 16-1037-01
Client: WBCM
Project: Bowie State University Parking Lot

Remarks:
○ Moisture content = 5.9%

Source of Sample: B-4
Depth: 1.0’ - 5.0’
Sample Number: Bulk

Findling, Inc.

Baltimore, Maryland
Particle Size Distribution Report

Project No. 16-1037-01  Client: WBCM  Remarks: Moisture content = 1.8%

Project: Bowie State University Parking Lot  Source of Sample: B-5  Depth: 4.0' - 6.0'  Sample Number: S-3

Findling, Inc.  Baltimore, Maryland  Figure

Material Description  USCS  AASHTO

<table>
<thead>
<tr>
<th>% +3&quot;</th>
<th>% Gravel</th>
<th>% Sand</th>
<th>% Fines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coarse</td>
<td>Fine</td>
<td>Coarse</td>
</tr>
<tr>
<td>○</td>
<td>0.0</td>
<td>0.0</td>
<td>22.0</td>
</tr>
<tr>
<td></td>
<td>○</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Grain Size - mm.

○ Light brown

Findling, Inc.
Baltimore, Maryland
**Particle Size Distribution Report**

---

**Material Description**

- **USCS**: CL
- **AASHTO**: A-6(5)

---

**Project No.** 16-1037-01  **Client**: WBCM

**Project**: Bowie State University Parking Lot

**Source of Sample**: SWM-1  **Depth**: 2.0' - 4.0'  **Sample Number**: S-2

---

**Project**  
Findling, Inc.

Baltimore, Maryland

**Remarks**: Moisture content = 18.8%

---

**Table**

<table>
<thead>
<tr>
<th>% +3&quot;</th>
<th>% Gravel</th>
<th>% Sand</th>
<th>% Fines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coarse</td>
<td>Fine</td>
<td>Coarse</td>
</tr>
<tr>
<td>0.0</td>
<td>0.0</td>
<td>3.3</td>
<td>3.7</td>
</tr>
</tbody>
</table>

---

**Figure**

**Light brown Sandy lean CLAY**
### Particle Size Distribution Report

#### Material Description

<table>
<thead>
<tr>
<th>% +3&quot;</th>
<th>% Gravel</th>
<th>% Sand</th>
<th>% Fines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coarse</td>
<td>Fine</td>
<td>Coarse</td>
</tr>
<tr>
<td>○</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>14.4</td>
<td>32.8</td>
<td>51.8</td>
<td></td>
</tr>
</tbody>
</table>

#### Particle Size Distribution

- **LL**: 35
- **PL**: 17
- **D<sub>85</sub>**: 0.0264
- **D<sub>60</sub>**: 0.0085
- **D<sub>50</sub>**: 0.0046
- **D<sub>30</sub>**: 0.0015
- **D<sub>15</sub>**: 0.0015
- **D<sub>10</sub>**: 0.0015
- **C<sub>p</sub>**: 0.0015
- **C<sub>u</sub>**: 0.0015

#### Project Information

- **Project No.**: 16-1037-01
- **Client**: WBCM
- **Project**: Bowie State University Parking Lot
- **Source of Sample**: SWM-2
- **Depth**: 4.0' - 6.0'
- **Sample Number**: S-3
- **Findling, Inc.**: Baltimore, Maryland
- **Remarks**: Moisture content = 20.3%
### Particle Size Distribution Report

#### GRAIN SIZE - mm.

<table>
<thead>
<tr>
<th>% +3&quot;</th>
<th>% Gravel</th>
<th>% Sand</th>
<th>% Fines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coarse</td>
<td>Fine</td>
<td>Coarse</td>
</tr>
<tr>
<td>○</td>
<td>0.0</td>
<td>0.0</td>
<td>3.1</td>
</tr>
</tbody>
</table>

#### LL PL % D85 D60 D50 D30 D15 D10 Cc CU

| ○ | 28 | 15 | 0.3471 |

#### Material Description

- Light grey

#### USCS AASHTO

- CL
- A-6(5)

#### Project Details

- **Project No.:** 16-1037-01
- **Client:** WBCM
- **Project:** Bowie State University Parking Lot
- **Source of Sample:** SWM-3
- **Depth:** 1.0' - 5.0'
- **Sample Number:** Bulk
- **Remark:** Moisture content = 17.6%

#### Findling, Inc.

Baltimore, Maryland
Particle Size Distribution Report

Material Description

PERCENT FINER

GRAIN SIZE - mm.

% +3"

% Gravel

% Sand

% Fines

% Coarse

% Fine

Coarse

Medium

Fine

Silt

Clay

0

6.2

2.8

10.0

32.3

27.1

21.6

Olive grey

SC

A-4(1)

0.0

0.0

0.5352

0.8073

0.0849

0.0117

0.0021

0.0

0.0

6.2

2.8

10.0

32.3

27.1

21.6

0.0

0.0

0.5352

0.8073

0.0849

0.0117

0.0021

0.0

0.0

0.5352

0.8073

0.0849

0.0117

0.0021

Olive grey

SC

A-4(1)

Findling, Inc.

Baltimore, Maryland

Remarks:

- Moisture content = 18.1%

Project No.: 16-1037-01  
Client: WBCM  
Project: Bowie State University Parking Lot  
Source of Sample: SWM-3  
Depth: 4.0’ - 6.0’  
Sample Number: S-3
# Particle Size Distribution Report

## Test Results

<table>
<thead>
<tr>
<th>% +3&quot;</th>
<th>% Gravel</th>
<th>% Sand</th>
<th>% Fines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coarse</td>
<td>Fine</td>
<td>Coarse</td>
</tr>
<tr>
<td>○</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>0.5</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LL</th>
<th>PL</th>
<th>D&lt;sub&gt;85&lt;/sub&gt;</th>
<th>D&lt;sub&gt;60&lt;/sub&gt;</th>
<th>D&lt;sub&gt;50&lt;/sub&gt;</th>
<th>D&lt;sub&gt;30&lt;/sub&gt;</th>
<th>D&lt;sub&gt;15&lt;/sub&gt;</th>
<th>D&lt;sub&gt;10&lt;/sub&gt;</th>
<th>C&lt;sub&gt;p&lt;/sub&gt;</th>
<th>C&lt;sub&gt;u&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>○</td>
<td>27</td>
<td>0.1104</td>
<td>0.0580</td>
<td>0.0367</td>
<td>0.0038</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Material Description
- Yellowish orange sandy Lean CLAY

#### Project Information
- **Project No.:** 16-1037-01
- **Client:** WBCM
- **Project:** Bowie State University Parking Lot
- **Source of Sample:** SWM-4
- **Depth:** 4.0' - 5.0'
- **Sample Number:** S-3

### Remarks
- Moisture content = 14.5%
Project No. 16-1037-01  Client: WBCM
Project: Bowie State University Parking Lot
 Remarks: Moisture content = 8.0%
Source of Sample: SWM-5  Depth: 2.0' - 4.0'  Sample Number: S-2

Findling, Inc.
Baltimore, Maryland
<table>
<thead>
<tr>
<th>% +3&quot;</th>
<th>% Gravel</th>
<th>% Sand</th>
<th>% Fines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coarse</td>
<td>Fine</td>
<td>Coarse</td>
</tr>
<tr>
<td>○</td>
<td>0.0</td>
<td>5.2</td>
<td>35.4</td>
</tr>
<tr>
<td></td>
<td>15.5</td>
<td>30.6</td>
<td>46.5</td>
</tr>
<tr>
<td>○</td>
<td>LL</td>
<td>PL</td>
<td>D$_{85}$</td>
</tr>
<tr>
<td>○</td>
<td>NV</td>
<td>NP</td>
<td>13.3586</td>
</tr>
</tbody>
</table>

Material Description

- Light brown

USCS: SP-SM
AASHTO: A-1-a

Project No.: 16-1037-01  Client: WBCM
Project: Bowie State University Parking Lot
Remarks: Moisture content = 2.5%

Source of Sample: SWM-6  Depth: 4.0' - 6.0'  Sample Number: S-3

Findling, Inc.
Baltimore, Maryland

Figure
Particle Size Distribution Report

Material Description

- Light brown Silty SAND

<table>
<thead>
<tr>
<th>% +3&quot;</th>
<th>% Gravel</th>
<th>% Sand</th>
<th>% Fines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coarse</td>
<td>Fine</td>
<td>Coarse</td>
</tr>
<tr>
<td>○</td>
<td>0.0</td>
<td>0.0</td>
<td>5.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- LL: 11.6, PL: 0.0, D_{85}: 1.1707, D_{60}: 0.2895, D_{50}: 0.2323, D_{30}: 0.1088

- USCS: SM, AASHTO: A-2-4(0)

Project No.: 16-1037-01  Client: WBCM
Project: Bowie State University Parking Lot

Source of Sample: SWM-7  Depth: 1.0' - 5.0'  Sample Number: Bulk

Findling, Inc.
Baltimore, Maryland

Remarks:
- Moisture content = 7.6%
Material Description

- Light brown poorly graded SAND with Silt and Gravel

USCS: SP-SM
AASHTO: A-1-b

Project No.: 16-1037-01  Client: WBCM
Project: Bowie State University Parking Lot
Remarks:
- Moisture content = 5.0%

Source of Sample: SWM-7  Depth: 4.0' - 6.0'  Sample Number: S-3

Findling, Inc.
Baltimore, Maryland
Particle Size Distribution Report

Material Description

<table>
<thead>
<tr>
<th>% +3&quot;</th>
<th>% Gravel</th>
<th>% Sand</th>
<th>% Fines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coarse</td>
<td>Fine</td>
<td>Coarse</td>
</tr>
<tr>
<td>0.0</td>
<td>0.0</td>
<td>16.4</td>
<td>15.1</td>
</tr>
</tbody>
</table>

Measurements (mm):
- LL: 5.15
- PL: 0.94
- D<sub>85</sub>: 0.47
- D<sub>50</sub>: 0.21
- D<sub>30</sub>: 0.04
- D<sub>15</sub>: 0.01
- C<sub>60</sub>: 3.8
- C<sub>U</sub>: 80.46

Light brown SM A-1-b

Project No.: 16-1037-01  Client: WBCM  Remarks: Moisture content = 9.7%

Source of Sample: SWM-8  Depth: 4.0' - 6.0'  Sample Number: S-3

Findling, Inc.
Baltimore, Maryland
### Particle Size Distribution Report

#### Material Description
- **Light brown Silty SAND**

#### Project Information
- **Project No.**: 16-1037-01
- **Client**: WBCM
- **Project**: Bowie State University Parking Lot
- **Source of Sample**: SWM-9
- **Depth**: 1.0' - 5.0'
- **Sample Number**: Bulk

#### Findling, Inc.

#### Project Details

<table>
<thead>
<tr>
<th>Source</th>
<th>Type</th>
<th>Width</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWM-9</td>
<td>Bulk</td>
<td>1.0' - 5.0'</td>
<td>Moisture content = 13.2%</td>
</tr>
</tbody>
</table>

#### Project Details

- **Permeability**: SM
- **AASHTO**: A-4(0)

#### Diagram

- **Gograin size - mm.**
- **PERCENT FINER**
- **GRAIN SIZE**
- **% +3”**
- **% Gravel**
- **% Sand**
- **% Fines**
  - Coarse
  - Fine
  - Coarse
  - Medium
  - Fine
  - Silt
  - Clay

<table>
<thead>
<tr>
<th>LL</th>
<th>PL</th>
<th>D85</th>
<th>D60</th>
<th>D50</th>
<th>D30</th>
<th>D15</th>
<th>D10</th>
<th>Cc</th>
<th>Cu</th>
</tr>
</thead>
<tbody>
<tr>
<td>NV</td>
<td>NP</td>
<td>0.8195</td>
<td>0.2712</td>
<td>0.1669</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Findling, Inc.

- **Baltimore, Maryland**
Particle Size Distribution Report

PERCENT FINER

GRAIN SIZE - mm.

<table>
<thead>
<tr>
<th>% +3&quot;</th>
<th>% Gravel</th>
<th>% Sand</th>
<th>% Fines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coarse</td>
<td>Fine</td>
<td>Coarse</td>
</tr>
<tr>
<td>○</td>
<td>0.0</td>
<td>0.0</td>
<td>1.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>□</td>
<td>LL</td>
<td>PL</td>
<td>D₈₅</td>
</tr>
<tr>
<td>○</td>
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<td>NP</td>
<td>0.6991</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Material Description

Light brown silty SAND

USCS | AASHTO
SM   | A-2-4(0)

Project No. 16-1037-01  Client: WBCM
Project: Bowie State University Parking Lot
Remarks:
○Moisture content = 9.6%

Source of Sample: SWM-9  Depth: 4.0' - 6.0'  Sample Number: S-3

Findling, Inc.

Baltimore, Maryland

Figure
Material Description: Redish poorly graded SAND with Silt

UL: NV, PL: NP

% +3"

GARIN SIZE - mm.

PERCENT FINER

GRAIN SIZE - mm.

% +3" % Gravel % Sand % Fines

Coarse Fine Coarse Medium Fine Silt Clay

0.0 0.0 27.7 12.5 21.2 27.5 4.7 6.4

PENETRANCE D85 D50 D30 D15 D10 Cc CU

NV NP 7.5682 2.0529 0.7595 0.3143 0.1466 0.0530 0.91 38.75

Material Description: Redish poorly graded SAND with Silt

USCS: SP-SM, AASHTO: A-1-b

Project No.: 16-1037-01, Client: WBCM

Project: Bowie State University Parking Lot

Source of Sample: SWM-10, Depth: 4.0' - 6.0', Sample Number: S-3

Findling, Inc.

Baltimore, Maryland

Remarks: Moisture content = 4.3%
Particle Size Distribution Report

Material Description

- Redish well-graded SAND with Silt and Gravel

USCS
AASHTO

- SW-SM
- A-1-b

Project No. 16-1037-01  Client:  WBCM  
Project:  Bowie State University Parking Lot  

Source of Sample: SWM-11  
Depth: 4.0’ - 6.0’  
Sample Number: S-3

Findling, Inc.  
Baltimore, Maryland  

Remarks:  Moisture content = 5.1%
Test specification: ASTM D 1557-00 Method A Modified

### Test Results

<table>
<thead>
<tr>
<th>Elev/Depth</th>
<th>Classification</th>
<th>USCS</th>
<th>AASHTO</th>
<th>Nat. Mois.</th>
<th>Sp.G.</th>
<th>LL</th>
<th>PI</th>
<th>% &gt; #4</th>
<th>% &lt; No.200</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0' - 5.0'</td>
<td>CL</td>
<td>CL</td>
<td>A-4(2)</td>
<td>12.4</td>
<td>23</td>
<td>9</td>
<td>6.0</td>
<td>58.2</td>
<td></td>
</tr>
</tbody>
</table>

**TEST RESULTS**

- Maximum dry density = 124.7 pcf
- Optimum moisture = 9.7%

**MATERIAL DESCRIPTION**

- Olive grey

**Project No.** 16-1037-01  **Client:** WBCM  
**Project:** Bowie State University Parking Lot

- **Source of Sample:** B-2  **Sample Number:** Bulk

**Findling, Inc.**

**Baltimore, Maryland**

**Remarks:** Figure
**COMPACTION TEST REPORT**

Test specification: ASTM D 1557-00 Method A Modified

<table>
<thead>
<tr>
<th>Elev/Depth</th>
<th>Classification USCS</th>
<th>Classification AASHTO</th>
<th>Nat. Moist.</th>
<th>Sp.G.</th>
<th>LL</th>
<th>PI</th>
<th>% &gt; #4</th>
<th>% &lt; No.200</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0' - 5.0'</td>
<td>SC</td>
<td>A-2-4(0)</td>
<td>5.8</td>
<td></td>
<td>20</td>
<td>8</td>
<td>25.3</td>
<td>28.3</td>
</tr>
</tbody>
</table>

**TEST RESULTS**

- Maximum dry density = 135.9 pcf
- Optimum moisture = 5.9%

**MATERIAL DESCRIPTION**

- Light brown Clayey SAND with Gravel

**Project No.** 16-1037-01  **Client:** WBCM
**Project:** Bowie State University Parking Lot

**Source of Sample:** B-4  **Sample Number:** Bulk

Findling, Inc.

Baltimore, Maryland
Test specification: ASTM D 1557-00 Method A Modified

<table>
<thead>
<tr>
<th>Elev/Depth</th>
<th>Classification</th>
<th>USCS</th>
<th>AASHTO</th>
<th>Nat. Moist.</th>
<th>Sp.G.</th>
<th>LL</th>
<th>PI</th>
<th>% &gt; #4</th>
<th>% &lt; No.200</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0' - 5.0'</td>
<td>CL</td>
<td>A-6(5)</td>
<td></td>
<td>17.6</td>
<td>28</td>
<td>13</td>
<td>3.1</td>
<td>62.5</td>
<td></td>
</tr>
</tbody>
</table>

Maximum dry density = 123.8 pcf

Optimum moisture = 10.6 %

Project No. 16-1037-01  Client: WBCM
Project: Bowie State University Parking Lot

Source of Sample: SWM-3  Sample Number: Bulk

Findling, Inc.

Baltimore, Maryland

Remarks: Figure
**COMPACTION TEST REPORT**

### Test Results

<table>
<thead>
<tr>
<th>Elev/Depth</th>
<th>Classification USCS</th>
<th>Classification AASHTO</th>
<th>Nat. Moist.</th>
<th>Sp.G.</th>
<th>LL</th>
<th>PI</th>
<th>% &gt; #4</th>
<th>% &lt; No.200</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0' - 5.0'</td>
<td>SM</td>
<td>A-2-4(0)</td>
<td>7.6</td>
<td>NV</td>
<td>NP</td>
<td>5.8</td>
<td>26.4</td>
<td></td>
</tr>
</tbody>
</table>

**TEST RESULTS**

- Maximum dry density = 119.9 pcf
- Optimum moisture = 9.0%

**MATERIAL DESCRIPTION**

- Light brown Silty SAND

### Remarks:

- **Project No.**: 16-1037-01  **Client**: WBCM
- **Project**: Bowie State University Parking Lot
- **Source of Sample**: SWM-7  **Sample Number**: Bulk
- **Findling, Inc.**
- **Baltimore, Maryland**
Dry density, pcf
110 115 120 125 130 135

Water content, %
3 5 7 9 11 13 15

8.3% 130.8 pcf

Test specification: ASTM D 1557-00 Method A Modified

<table>
<thead>
<tr>
<th>Elev/Depth</th>
<th>Classification</th>
<th>USCS</th>
<th>AASHTO</th>
<th>Nat. Moist.</th>
<th>Sp.G.</th>
<th>LL</th>
<th>PI</th>
<th>% &gt; #4</th>
<th>% &lt; No.200</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0' - 5.0'</td>
<td>SM</td>
<td>A-4(0)</td>
<td>13.2</td>
<td>NV</td>
<td>NP</td>
<td>6.6</td>
<td>43.6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Maximum dry density = 130.8 pcf
Optimum moisture = 8.3%

Project No. 16-1037-01  Client: WBCM
Project: Bowie State University Parking Lot
Source of Sample: SWM-9  Sample Number: Bulk
Findling, Inc.

Baltimore, Maryland

Light brown Silty SAND

Remarks: Figure
### CALIFORNIA BEARING RATIO (CBR) TEST

**PROJECT NAME:** Bowie State University Parking Area  
**PROJECT NO:** 16-1037-01  
**LAB SAMPLE ID:** BULK

**SAMPLE DESCRIPTION:** Olive grey lean CLAY (CL)  
**BORING NUMBER:** B-2

**CBR TEST METHOD:** ASTM, D1883 (96 Hours Soaked)  
**MAX. DRY DENSITY (pcf):** 124.7  
**OPT. MOISTURE CONTENT:** 9.7%  
**DEPTH, (FT):** 1.0'-5.0'

(Modified Proctor, D-1557)

<table>
<thead>
<tr>
<th>TEST-1</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DRY DENSITY (pcf):</td>
<td>122.0</td>
<td>MOISTURE CONTENT:</td>
<td>9.5%</td>
</tr>
<tr>
<td>% COMPACTION OF MODIFIED PROCTOR (T-180):</td>
<td>97.9%</td>
<td>% SWELL:</td>
<td>-0.2%</td>
</tr>
<tr>
<td>CBR @ 0.1:</td>
<td>6.4</td>
<td>CBR @ 0.2:</td>
<td>8.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEST-2</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DRY DENSITY (pcf):</td>
<td>117.7</td>
<td>MOISTURE CONTENT:</td>
<td>9.9%</td>
</tr>
<tr>
<td>% COMPACTION OF MODIFIED PROCTOR (T-180):</td>
<td>94.4%</td>
<td>% SWELL:</td>
<td>0.0%</td>
</tr>
<tr>
<td>CBR @ 0.1:</td>
<td>2.9</td>
<td>CBR @ 0.2:</td>
<td>3.3</td>
</tr>
</tbody>
</table>

CBR at 95% Compaction = 3.5

---

**CBR Results**

![CBR Results Graph](chart.png)
## CALIFORNIA BEARING RATIO TEST

**PROJECT NAME:** Bowie State University Parking Area  
**PROJECT NO:** 16-1037-01  
**LAB SAMPLE ID:** BULK  

**SAMPLE DESCRIPTION:** Olive grey lean CLAY (CL)  
**BORING NUMBER:** B-2  

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. DRY DENSITY (pcf)</td>
<td>124.7</td>
</tr>
<tr>
<td>(Modified Proctor, ASTM D 1557)</td>
<td></td>
</tr>
<tr>
<td>Opt. MOISTURE CONTENT</td>
<td>9.7%</td>
</tr>
<tr>
<td>Depth, (FT)</td>
<td>1.0'-5.0'</td>
</tr>
<tr>
<td>Dry Density (pcf)</td>
<td>122.0</td>
</tr>
<tr>
<td>Moisture Content</td>
<td>9.5%</td>
</tr>
<tr>
<td>% Swell</td>
<td>-0.2%</td>
</tr>
<tr>
<td>CBR @ 0.1</td>
<td>6.4</td>
</tr>
<tr>
<td>CBR @ 0.2</td>
<td>8.8</td>
</tr>
<tr>
<td>Method</td>
<td>ASTM, D1883 (96 Hours Soaked)</td>
</tr>
<tr>
<td>% Compaction of Modified Proctor (T-180)</td>
<td>97.9%</td>
</tr>
</tbody>
</table>

![CBR Test Graph](image)
CALIFORNIA BEARING RATIO TEST

PROJECT NAME: Bowie State University Parking Area  PROJECT NO: 16-1037-01  LAB SAMPLE ID: BULK

SAMPLE DESCRIPTION: Olive grey lean CLAY (CL)  BORING NUMBER: B-2

MAX. DRY DENSITY (pcf): 124.7
(Modified Proctor, ASTM D 1557)

DRY DENSITY (pcf): 117.7

OPT. MOISTURE CONTENT: 9.7%

MOISTURE CONTENT: 9.9%

DEPTH, (FT): 1.0'-5.0'

% SWELL: 0.0%

CBR @ 0.1: 2.9
CBR @ 0.2: 3.3

METHOD: ASTM D1883, 96 Hours Soaked  % COMPACTION OF MODIFIED PROCTOR (T-180): 94.4%

<table>
<thead>
<tr>
<th>PENETRATION RESISTANCE - PSI</th>
<th>PENETRATION - INCHES</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>20.00</td>
<td>0.10</td>
</tr>
<tr>
<td>40.00</td>
<td>0.20</td>
</tr>
<tr>
<td>60.00</td>
<td>0.30</td>
</tr>
<tr>
<td>80.00</td>
<td>0.40</td>
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<tr>
<td>100.00</td>
<td>0.50</td>
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<tr>
<td>120.00</td>
<td>0.60</td>
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<tr>
<td>140.00</td>
<td>0.70</td>
</tr>
<tr>
<td>160.00</td>
<td>0.80</td>
</tr>
</tbody>
</table>

CBR TEST
CALIFORNIA BEARING RATIO (CBR) TEST

PROJECT NAME: Bowie State University Parking Area
PROJECT NO: 16-1037-01
LAB SAMPLE ID: BULK

SAMPLE DESCRIPTION: Clayey SAND (SC)
BORING NUMBER: B-4

CBR TEST METHOD: ASTM, D1883 (96 Hours Soaked)

MAX. DRY DENSITY (pcf): 135.9
OPT. MOISTURE CONTENT: 5.9%
DEPTH, (FT): 1.0'-5.0'

TEST-1
DRY DENSITY (pcf): 138.3
MOISTURE CONTENT: 7.0%
% COMPACTION OF MODIFIED PROCTOR (T-180): 101.8%
CBR @ 0.1: 19.1
CBR @ 0.2: 25.8

TEST-2
DRY DENSITY (pcf): 126.8
MOISTURE CONTENT: 6.8%
% COMPACTION OF MODIFIED PROCTOR (T-180): 93.3%
CBR @ 0.1: 7.4
CBR @ 0.2: 7.8

CBR at 95% Compaction = 9.7

CBR Results

Percent Compaction, %

CBR

0.0 5.0 10.0 15.0 20.0 25.0

85 90 95 100 105
CALIFORNIA BEARING RATIO TEST

PROJECT NAME: Bowie State University Parking Area  PROJECT NO: 16-1037-01  LAB SAMPLE ID: BULK

SAMPLE DESCRIPTION: Clayey SAND (SC)  BORING NUMBER: B-4

MAX. DRY DENSITY (pcf): 135.9  OPT. MOISTURE CONTENT: 5.9%  DEPTH, (FT): 1.0'-5.0'

(Destroyed Proctor, ASTM D 1557)

DRY DENSITY (pcf): 138.3  MOISTURE CONTENT: 7.0%  % SWELL: 0.0%

CBR @ 0.1: 19.1  CBR @ 0.2: 25.8

METHOD: ASTM, D1883 (96 Hours Soaked)  % COMPACTION OF MODIFIED PROCTOR (T-180): 101.8%

CBR TEST

PENETRATION RESISTANCE - PSI

PENETRATION - INCHES
CALIFORNIA BEARING RATIO TEST

PROJECT NAME: Bowie State University Parking Area  PROJECT NO: 16-1037-01  LAB SAMPLE ID: BULK

SAMPLE DESCRIPTION: Clayey SAND (SC)  BORING NUMBER: B-4

MAX. DRY DENSITY (pcf): 135.9  OPT. MOISTURE CONTENT: 5.9%  DEPTH, (FT): 1.0'-5.0'

(Modified Proctor, ASTM D 1557)

DRY DENSITY (pcf): 126.8  MOISTURE CONTENT: 6.8%  % SWELL: 0.1%

CBR @ 0.1: 7.4  CBR @ 0.2: 7.8

METHOD: ASTM D1883, 96 Hours Soaked  % COMPACTION OF MODIFIED PROCTOR (T-180): 93.3%

CBR TEST

![Graph showing CBR test results](image-url)
## Summary of Infiltration Test Results

Parking Area and SWM Facility  
Bowie State University  
Bowie, PG County, MD  
Findling, Inc. Project No.: 16-1037-01

<table>
<thead>
<tr>
<th>SWM</th>
<th>Infiltration Test ID</th>
<th>Adjacent to Test Boring</th>
<th>Existing Ground Elev. (ft.)</th>
<th>Infiltration Test Depth (ft.)</th>
<th>24 Hr. Pre-Soak Drop (in)</th>
<th>Water Level Drop (inches)</th>
<th>Average Infiltration Rate, inch/hour</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0 - 1 Hr.</td>
<td>1 - 2 Hr.</td>
<td>2 - 3 Hr.</td>
</tr>
<tr>
<td>SWM-1</td>
<td>SWM-1</td>
<td>SWM-1</td>
<td>108.2</td>
<td>2.5</td>
<td>23.2</td>
<td>3.2</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>SWM-2</td>
<td>SWM-2</td>
<td>SWM-2</td>
<td>105.7</td>
<td>3.0</td>
<td>10.8</td>
<td>1.8</td>
<td>1.9</td>
<td>1.9</td>
</tr>
<tr>
<td>SWM-3</td>
<td>SWM-3</td>
<td>SWM-3</td>
<td>103.0</td>
<td>3.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>SWM-4</td>
<td>SWM-4</td>
<td>SWM-4</td>
<td>107.5</td>
<td>2.5</td>
<td>0.8</td>
<td>0.0</td>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td>SWM-5</td>
<td>SWM-5</td>
<td>SWM-5</td>
<td>106.0</td>
<td>3.0</td>
<td>4.4</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>SWM-6</td>
<td>SWM-6</td>
<td>SWM-6</td>
<td>107.5</td>
<td>4.0</td>
<td>24.0</td>
<td>114.6</td>
<td>69.6</td>
<td>57.4</td>
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<tr>
<td>SWM-7</td>
<td>SWM-7</td>
<td>SWM-7</td>
<td>114.0</td>
<td>4.0</td>
<td>24.0</td>
<td>10.0</td>
<td>7.8</td>
<td>8.0</td>
</tr>
<tr>
<td>SWM-8</td>
<td>SWM-8</td>
<td>SWM-8</td>
<td>111.3</td>
<td>4.0</td>
<td>0.5</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>SWM-9</td>
<td>SWM-9</td>
<td>SWM-9</td>
<td>119.0</td>
<td>5.0</td>
<td>24.0</td>
<td>69.6</td>
<td>52.4</td>
<td>32.9</td>
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<tr>
<td>SWM-10</td>
<td>SWM-10</td>
<td>SWM-10</td>
<td>117.4</td>
<td>5.0</td>
<td>24.0</td>
<td>60.1</td>
<td>49.0</td>
<td>31.1</td>
</tr>
<tr>
<td>SWM-11</td>
<td>SWM-11</td>
<td>SWM-11</td>
<td>117.6</td>
<td>5.0</td>
<td>24.0</td>
<td>31.4</td>
<td>19.8</td>
<td>18.4</td>
</tr>
</tbody>
</table>

**Note:**  
Test depths are measured from the existing ground surface.  
Infiltration test hole was backfilled with Bentonite.
# BORING LOG

**Contract No.:** 16-1037-01  
**Project Description:** Bowie State University Parking Lot

**Boring No.:** B-1  
**Station:** , '  
**Ground Surface Elevation:** 114.0 ft

**Easting:** 1380642.12  
**Northing:** 493736.05

**Date Started:** 9/17/18  
**Date Completed:** 9/17/18

**Inspector:** D. Tajhya  
**Logged by:** D. Fincham

## WATER TABLE

<table>
<thead>
<tr>
<th>Depth Below Surface</th>
<th>Time (hours)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>END</td>
<td>9/17/18</td>
</tr>
<tr>
<td>2.0</td>
<td>24 hrs</td>
<td>9/18/18</td>
</tr>
</tbody>
</table>

## CAVE-IN TABLE

<table>
<thead>
<tr>
<th>Depth Below Surface</th>
<th>Time (hours)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.5</td>
<td>106.4</td>
<td>END</td>
</tr>
<tr>
<td>7.5</td>
<td>106.5</td>
<td>24 hrs</td>
</tr>
</tbody>
</table>

## DEPTH IN FEET

<table>
<thead>
<tr>
<th>MATERIAL DESCRIPTION</th>
<th>NMC (%)</th>
<th>LL (%)</th>
<th>PI (%)</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 Topsoil = 6&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0 Brown, grey, moist, very loose, Silty Clayey SAND (SC-SM), little Roots (FILL)</td>
<td>20</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.5 Brown, damp, very loose SAND (SP), little Silt, Gravel, Metal; trace Brick, Glass (FILL)</td>
<td>20</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.5 Multi-brown, damp to moist, dense SAND (SP) with Gravel, trace to little Silt</td>
<td>20</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.0 Brown, tan, red, damp, stiff SILT (ML), little Clay, trace Sand</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bottom of Boring @ 10'</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## REMARKS

- EL is approximated from Boring Plan provided

---

**Legend:**
- NMC - Natural Moisture Content
- PI - Plasticity Index
- REC - Recovery
- MATL - Material Graphics
- SPT - Standard Penetration Test
- OD - Outside Diameter
- Boring and Sampling Conforms to ASTM/AASHTO.
**BORING LOG**

**Contract No.:** 16-1037-01  **Project Description:** Bowie State University Parking Lot

**Boring No.:** B-2  **Station:**

**Easting:** 1380710.55  **Northing:** 493853.94

**Date Started:** 9/10/18  **Date Completed:** 9/10/18

**Inspector:** D. Tajhya  **Driller:** D. Fincham

**Ground Surface Elevation:** 110.5 ft

**Logged by:** D. Tajhya

---

**WATER TABLE**

<table>
<thead>
<tr>
<th>Depth Below Surface</th>
<th>Time (hours)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.0 ft</td>
<td>END</td>
<td>9/10/18</td>
</tr>
<tr>
<td>24 hrs</td>
<td>9/11/18</td>
<td></td>
</tr>
</tbody>
</table>

**CAVE-IN TABLE**

<table>
<thead>
<tr>
<th>Depth Below Surface</th>
<th>Time (hours)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.6 ft</td>
<td>END</td>
<td>9/10/18</td>
</tr>
<tr>
<td>103.9 ft</td>
<td></td>
<td>9/10/18</td>
</tr>
<tr>
<td>5.7 ft</td>
<td>END</td>
<td>9/10/18</td>
</tr>
<tr>
<td>104.8 ft</td>
<td>24 hrs</td>
<td>9/11/18</td>
</tr>
</tbody>
</table>

---

**DEPT IN FEET**

<table>
<thead>
<tr>
<th>SAMPLE NO.</th>
<th>MATERIAL DESCRIPTION</th>
<th>BLOWS/RQD</th>
<th>SAMPLE DEPTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Topsoil = 12&quot;</td>
<td>1-1-5-2</td>
<td>0.0-2.0</td>
</tr>
<tr>
<td>2</td>
<td>HMA Fragments = 2&quot;</td>
<td>2-5-6-7</td>
<td>2.0-4.0</td>
</tr>
<tr>
<td>3</td>
<td>Orange, brown, moist, very loose SAND (SP), little Silt (FILL)</td>
<td>4-4-8-11</td>
<td>4.0-6.0</td>
</tr>
<tr>
<td>4</td>
<td>Grey, brown, moist, medium stiff Lean CLAY (CL) with Sand, little Wood, Gravel (FILL)</td>
<td>32-29-13-8</td>
<td>6.0-8.0</td>
</tr>
<tr>
<td>5</td>
<td>Concrete Fragments (FILL), Brown, moist, very dense SAND (SP) with Gravel, little Silt</td>
<td>7-11-13-15</td>
<td>8.0-10.0</td>
</tr>
</tbody>
</table>

---

**LAB. INDEX TESTS**

<table>
<thead>
<tr>
<th>SAMPLE NO.</th>
<th>MATERIAL DESCRIPTION</th>
<th>BLOWS/RQD</th>
<th>SAMPLE DEPTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Topsoil = 12&quot;</td>
<td>1-1-5-2</td>
<td>0.0-2.0</td>
</tr>
<tr>
<td>2</td>
<td>HMA Fragments = 2&quot;</td>
<td>2-5-6-7</td>
<td>2.0-4.0</td>
</tr>
<tr>
<td>3</td>
<td>Orange, brown, moist, very loose SAND (SP), little Silt (FILL)</td>
<td>4-4-8-11</td>
<td>4.0-6.0</td>
</tr>
<tr>
<td>4</td>
<td>Grey, brown, moist, medium stiff Lean CLAY (CL) with Sand, little Wood, Gravel (FILL)</td>
<td>32-29-13-8</td>
<td>6.0-8.0</td>
</tr>
<tr>
<td>5</td>
<td>Concrete Fragments (FILL), Brown, moist, very dense SAND (SP) with Gravel, little Silt</td>
<td>7-11-13-15</td>
<td>8.0-10.0</td>
</tr>
</tbody>
</table>

---

**REMARKS**

<table>
<thead>
<tr>
<th>SAMPLE NO.</th>
<th>MATERIAL DESCRIPTION</th>
<th>BLOWS/RQD</th>
<th>SAMPLE DEPTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Topsoil = 12&quot;</td>
<td>1-1-5-2</td>
<td>0.0-2.0</td>
</tr>
<tr>
<td>2</td>
<td>HMA Fragments = 2&quot;</td>
<td>2-5-6-7</td>
<td>2.0-4.0</td>
</tr>
<tr>
<td>3</td>
<td>Orange, brown, moist, very loose SAND (SP), little Silt (FILL)</td>
<td>4-4-8-11</td>
<td>4.0-6.0</td>
</tr>
<tr>
<td>4</td>
<td>Grey, brown, moist, medium stiff Lean CLAY (CL) with Sand, little Wood, Gravel (FILL)</td>
<td>32-29-13-8</td>
<td>6.0-8.0</td>
</tr>
<tr>
<td>5</td>
<td>Concrete Fragments (FILL), Brown, moist, very dense SAND (SP) with Gravel, little Silt</td>
<td>7-11-13-15</td>
<td>8.0-10.0</td>
</tr>
</tbody>
</table>

**Legend:**

- **NMC**: Natural Moisture Content
- **PI**: Plasticity Index
- **REC**: Recovery
- **MATL**: Material Graphics
- **RQD**: Rock Quality Designation
- **LL**: Liquid Limit
- **OD**: Outside Diameter
- **SPT**: Standard Penetration Test
- **SPOON/ROCK CORE**: Spoon/Rock Core
- **BLOWS**: Bounces
- **RQD**: Rock Quality Designation
- **SAMPLE NO.**: Sample Number
- **SAMPLE DEPTH**: Sample Depth
- **REMARKS**: Remarks
- **LAB. INDEX TESTS**: Laboratory Index Tests

---

**Environmetrics & Geosystems**

FINDLING, INC.
**BORING LOG**

**Contract No.:** 16-1037-01  
**Project Description:** Bowie State University Parking Lot

<table>
<thead>
<tr>
<th>Depth Below Surface</th>
<th>Material Description</th>
<th>Sample No.</th>
<th>BLOWS/RQD</th>
<th>SAMPLE DEPTH</th>
<th>REC. SPOON/ROCK CORE</th>
<th>LAB. INDEX TESTS</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.7 109.80</td>
<td>Topsoil = 8&quot; Grey, brown, moist, loose Silty Clayey SAND (SC-SM), trace to little Gravel, Wood (FILL)</td>
<td>WOH-2-3-3</td>
<td>0.0-2.0</td>
<td>24</td>
<td>EL is approximated from Boring Plan provided</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.5 106.00</td>
<td>Brown, moist, medium dense SAND (SP), some Gravel, little Silt and Clay (FILL)</td>
<td>3-3-3-7</td>
<td>4.0-6.0</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.5 105.00</td>
<td>Red, brown, tan, damp, very stiff SILT (ML), little Clay, trace Sand</td>
<td>4-11-10-8</td>
<td>0.0-2.0</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.0 100.50</td>
<td>Bottom of Boring @ 10'</td>
<td>7-10-13-17</td>
<td>8.0-10.0</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Legend:**
- NMC - Natural Moisture Content  
- PI - Plasticity Index  
- REC - Recovery  
- MATL - Material Graphics  
- SPT - Standard Penetration Test  
- OD - Outside Diameter  
- LL - Liquid Limit  
- Elev - Elevation  
- Geotech - Geotechnical  
- RQD - Rock Quality Designation  
- Elev - Elevation  
- Geotech - Geotechnical  
- OD - Outside Diameter  

**Data from Boring and Sampling:**
- Conforms to ASTM/AASHTO:
  - Rig Type: Track 45
  - Rig No.: R-3
  - Drive Hammer Weight: 140 LB
  - Auger Size: 3-1/4 IN
  - Size of Core: IN
  - Size of Bit OD: IN
  - Hammer Energy Ratio: %
  - Auger Depth: 10 FT

**WATER TABLE**

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Elev (ft)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.3</td>
<td>105.2</td>
<td>9/10/18</td>
</tr>
<tr>
<td>5.6</td>
<td>104.9</td>
<td>9/11/18</td>
</tr>
</tbody>
</table>

**CAVE-IN TABLE**

<table>
<thead>
<tr>
<th>Depth Below Surface (ft)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.9</td>
<td>END 9/10/18</td>
</tr>
<tr>
<td>5.6</td>
<td>END 9/11/18</td>
</tr>
</tbody>
</table>
**BORING LOG**

Contract No.: 16-1037-01  
Project Description: Bowie State University Parking Lot

Boring No.: B-4  
Station:  
Easting: 1380925.61  
Northing: 493971.54  
Ground Surface Elevation: 110.0 ft

Date Started: 9/10/18  
Date Completed: 9/10/18  
Logged by: D. Tajhya

**WATER TABLE**

<table>
<thead>
<tr>
<th>Depth Below Surface (ft)</th>
<th>Elev (ft)</th>
<th>Time (hours)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.9</td>
<td>104.1</td>
<td>END</td>
<td>9/10/18</td>
</tr>
<tr>
<td>5.3</td>
<td>104.7</td>
<td>24 hrs</td>
<td>9/11/18</td>
</tr>
</tbody>
</table>

**CAVE-IN TABLE**

<table>
<thead>
<tr>
<th>Depth Below Surface (ft)</th>
<th>Elev (ft)</th>
<th>Time (hours)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1</td>
<td>103.9</td>
<td>END</td>
<td>9/10/18</td>
</tr>
<tr>
<td>5.7</td>
<td>104.3</td>
<td>24 hrs</td>
<td>9/11/18</td>
</tr>
</tbody>
</table>

**MATERIAL DESCRIPTION**

- **Topsoil = 6"**
  - Multi-brown, grey, moist, loose, Silty Clayey SAND (SC-SM), little Gravel (FILL)
- Red, brown, moist, medium dense Clayey SAND (SC), some Gravel, little Silt
- Orange, brown, moist, dense SAND (SP) with Gravel, trace Silt
- Orange, brown, moist to wet, dense SAND (SP), trace Gravel, Silt
- Red, tan, damp, very stiff SILT (ML), little Clay, trace Sand

Bottom of Boring @ 10'

**LAKE TABLE**

| Elev (ft) | Ground Surface Elevation: 110.0 ft | EL is approximated from Boring Plan provided |

**BEDROCK**

**Remarks**

<table>
<thead>
<tr>
<th>Date</th>
<th>Time (hours)</th>
<th>Depth (ft)</th>
<th>Elev (ft)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/10/18</td>
<td>104.3</td>
<td>24 hrs</td>
<td>9/11/18</td>
<td>Bulk sample @ 1.0'-5.0'</td>
</tr>
</tbody>
</table>

**LAB. INDEX TESTS**

<table>
<thead>
<tr>
<th>DEPTH IN FEET</th>
<th>ELEV. IN FEET</th>
<th>MATERIAL DESCRIPTION</th>
<th>SAMPLE NO.</th>
<th>BLOWS/RQD</th>
<th>SPT (in) or Core (%)</th>
<th>NMC (%)</th>
<th>LL (%)</th>
<th>PI (%)</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>109.50</td>
<td>Topsoil = 6&quot;</td>
<td>1</td>
<td>1-2-6-6</td>
<td>0.0-2.0</td>
<td>22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td>108.00</td>
<td>Multi-brown, grey, moist, loose, Silty Clayey SAND (SC-SM), little Gravel (FILL)</td>
<td>2</td>
<td>6-6-6-8</td>
<td>2.0-4.0</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.0</td>
<td>106.00</td>
<td>Red, brown, moist, medium dense Clayey SAND (SC), some Gravel, little Silt</td>
<td>3</td>
<td>9-19-27-19</td>
<td>4.0-6.0</td>
<td>18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.5</td>
<td>104.50</td>
<td>Orange, brown, moist, dense SAND (SP) with Gravel, trace Silt</td>
<td>4</td>
<td>8-9-12-15</td>
<td>6.0-8.0</td>
<td>22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.5</td>
<td>103.50</td>
<td>Orange, brown, moist to wet, dense SAND (SP), trace Gravel, Silt</td>
<td>5</td>
<td>8-11-14-18</td>
<td>8.0-10.0</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.0</td>
<td>100.00</td>
<td>Red, tan, damp, very stiff SILT (ML), little Clay, trace Sand</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Bulk sample @ 1.0'-5.0'</td>
</tr>
</tbody>
</table>

**Legend:**
- NMC - Natural Moisture Content
- PI - Plasticity Index
- REC - Recovery
- MATL - Material Graphics
- SPT - Standard Penetration Test

**Conforms to ASTM/AASHTO:**
- RQD - Rock Quality Designation
- LL - Liquid Limit
- OD - Outside Diameter
**Contract No.:** 16-1037-01  
**Project Description:** Bowie State University Parking Lot

**Boring No.:** B-5  
**Station:** , '  
**Easting:** 1381033.17  
**Northing:** 493970.28  
**Date Started:** 9/10/18  
**Date Completed:** 9/10/18  
**Inspector:** D. Tajhya  
**Driller:** D. Fincham  

**Ground Surface Elevation:** 113.5 ft

---

**WATER TABLE**

<table>
<thead>
<tr>
<th>Depth Below Surface</th>
<th>Time (hours)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>END 4.9</td>
<td>108.6 END</td>
<td>9/10/18</td>
</tr>
<tr>
<td>END 4.9</td>
<td>108.6 END</td>
<td>9/10/18</td>
</tr>
</tbody>
</table>

---

**CAVE-IN TABLE**

<table>
<thead>
<tr>
<th>Rig Type</th>
<th>Track 45</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rig No.</td>
<td>R-3</td>
</tr>
<tr>
<td>Drive Hammer Weight</td>
<td>140 LB</td>
</tr>
<tr>
<td>Auger Size</td>
<td>3-1/4 IN</td>
</tr>
<tr>
<td>Size of Core</td>
<td>IN</td>
</tr>
<tr>
<td>Size of Bit OD</td>
<td>IN</td>
</tr>
<tr>
<td>Hammer Energy Ratio</td>
<td>%</td>
</tr>
<tr>
<td>Auger Depth</td>
<td>10 FT</td>
</tr>
</tbody>
</table>

---

**DEPTH IN FEET**  
**ELEV. IN FEET**  
**MATL**  
**MATERIAL DESCRIPTION**  
**SPT SPOON/ROCK CORE**  
**LAB. INDEX TESTS**  
**REMARKS**

<table>
<thead>
<tr>
<th>SAMPLE</th>
<th>BLOWS/RQD</th>
<th>SAMPLE DEPTH</th>
<th>SPT(in) or Core (%)</th>
<th>NMC (%)</th>
<th>LL (%)</th>
<th>PI (%)</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2-2-2-4</td>
<td>0.0-2.0</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td>EL is approximated from Boring Plan provided</td>
</tr>
<tr>
<td>2</td>
<td>9-9-9-9</td>
<td>2.0-4.0</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td>Bulk sample @ 1.0'-5.0'</td>
</tr>
<tr>
<td>3</td>
<td>5-7-9-9</td>
<td>4.0-6.0</td>
<td>18</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>8-11-10-10</td>
<td>6.0-8.0</td>
<td>22</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>8-17-18-14</td>
<td>8.0-10.0</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td>Water on Rod @ 9.5'</td>
</tr>
</tbody>
</table>

---

**Legend:**  
NMC - Natural Moisture Content  
PI - Plasticity Index  
REC - Recovery  
MATL - Material Graphics  
SPT - Standard Penetration Test  
ROQ - Rock Quality Designation  
LL - Liquid Limit  
Elev - Elevation  
Geotech - Geotechnical  
OD - Outside Diameter

---

**DATE:** 9/10/18  
**D. Fincham**

---

**DATE:** 9/11/18  
**D. Tajhya**

---

**PROJECT:** 16-1037-01 WBCM BOWIE STATE UNIVERSITY PARKING LOT.GPJ-10/15/18

**CONTRACT:** Bowie State University Parking Lot

**ELEV. IN FEET**

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>Topsoil = 6&quot;</td>
</tr>
<tr>
<td>2.0</td>
<td>Brown, moist, very loose, Silty Clayey SAND (SC-SM), little Gravel, Roots (FILL)</td>
</tr>
<tr>
<td>8.0</td>
<td>Red, brown, damp, medium dense SAND (SP) with Gravel, trace Silt</td>
</tr>
<tr>
<td>10.0</td>
<td>Brown, tan, moist towet, dense SAND (SP), some Gravel, trace Silt</td>
</tr>
</tbody>
</table>

**Depth of Boring @ 10'**
**BORING LOG**

**Contract No.:** 16-1037-01  
**Project Description:** Bowie State University Parking Lot

**Boring No.:** SWM-1  
**Station:**  
**Easting:** 1380540.18  
**Northing:** 493776.85  
**Ground Surface Elevation:** 108.2 ft  
**Date Started:** 9/12/18  
**Date Completed:** 9/12/18  
**Logged by:** D. Tajhya  
**Inspector:** D. Tajhya  
**Driller:** D. Fincham

---

**WATER TABLE**

<table>
<thead>
<tr>
<th>Depth Below Surface</th>
<th>Time (hours)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>F 3.0</td>
<td>END</td>
<td>9/12/18</td>
</tr>
<tr>
<td>V 5.0</td>
<td>24 hrs</td>
<td>9/13/18</td>
</tr>
</tbody>
</table>

---

**CAVE-IN TABLE**

<table>
<thead>
<tr>
<th>Depth Below Surface</th>
<th>Time (hours)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>ML 8.2</td>
<td>END</td>
<td>9/12/18</td>
</tr>
<tr>
<td>ML 3.9</td>
<td>24 hrs</td>
<td>9/13/18</td>
</tr>
</tbody>
</table>

---

**DEPTH IN FEET**

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>ELEV. (ft)</th>
<th>MATERIAL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>108.00</td>
<td>Topsoil = 6&quot;</td>
</tr>
<tr>
<td>2.0</td>
<td>106.50</td>
<td>Brown, damp, medium dense SAND (SP), some Silt, Gravel (FILL)</td>
</tr>
<tr>
<td>4.0</td>
<td>104.50</td>
<td>Orange brown, moist, medium stiff CLAY (CL), some Sand, little Silt, trace Gravel (FILL)</td>
</tr>
<tr>
<td>5.0</td>
<td>103.50</td>
<td>Brown, wet, very loose SAND (SP), little Silt, Clay, trace Gravel (FILL)</td>
</tr>
<tr>
<td>8.0</td>
<td>100.50</td>
<td>Red, tan, moist, very stiff, Silty CLAY (CL), trace Sand (FILL)</td>
</tr>
<tr>
<td>10.0</td>
<td>98.50</td>
<td>Multi-brown, red, moist, very stiff, Silty CLAY (CL), some Sand, little Gravel (FILL)</td>
</tr>
<tr>
<td>12.0</td>
<td>96.50</td>
<td>Red, brown, damp, very stiff SILT (ML), little Clay, trace Sand</td>
</tr>
</tbody>
</table>

**SPT SPOON/ROCK CORE**

<table>
<thead>
<tr>
<th>SAMPLE NO.</th>
<th>BLOWS/ RQD</th>
<th>SAMPLE DEPTH</th>
<th>SPT (in) or Core (%)</th>
<th>REC.</th>
<th>LAB. INDEX TESTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2-4-7-11</td>
<td>0.0-2.0</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>4-3-2-1</td>
<td>2.0-4.0</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>WOH-2-7-10</td>
<td>4.0-6.0</td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>9-10-10-11</td>
<td>6.0-8.0</td>
<td>24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>8-10-11-9</td>
<td>8.0-10.0</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>3-8-10-10</td>
<td>10.0-12.0</td>
<td>8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**REMARKS**

- EL is approximated from Boring Plan provided
- Used 3" spoon to get sample from S-2, S-3 and S-4
- Bottom of Boring @ 12'

---

**Legend:**
- NMC - Natural Moisture Content
- PI - Plasticity Index
- REC - Recovery
- MATL - Material Graphics
- SPT - Standard Penetration Test
- RQD - Rock Quality Designation
- LL - Liquid Limit
- ELEV. - Elevation
- OD - Outside Diameter
- CONFORMS TO ASTM/AASHTO
**BORING LOG**

**Contract No.:** 16-1037-01  
**Project Description:** Bowie State University Parking Lot

**Boring No.:** SWM-2  
**Station:** ,  
**Easting:** 1380586.43  
**Northing:** 493877.07

**Date Started:** 9/12/18  
**Date Completed:** 9/12/18  
**Logged by:** D. Tajhya

---

**Legend:**  
- NMC - Natural Moisture Content  
- PI - Plasticity Index  
- REC - Recovery  
- MATL - Material Graphics  
- SPT - Standard Penetration Test  
- LL - Liquid Limit  
- PI - Plasticity Index  
- OD - Outside Diameter

---

**WATER TABLE**

<table>
<thead>
<tr>
<th>Depth Below Surface (ft)</th>
<th>Elev (ft)</th>
<th>Time (hours)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0</td>
<td>103.5</td>
<td>24 hrs</td>
<td>9/13/18</td>
</tr>
</tbody>
</table>

**CAVE-IN TABLE**

<table>
<thead>
<tr>
<th>Depth Below Surface (ft)</th>
<th>Elev (ft)</th>
<th>Time (hours)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.7</td>
<td>97.8</td>
<td>END</td>
<td>9/12/18</td>
</tr>
<tr>
<td>3.2</td>
<td>102.3</td>
<td>24 hrs</td>
<td>9/13/18</td>
</tr>
</tbody>
</table>

**Depth Below Surface (ft)**

<table>
<thead>
<tr>
<th>Depth Below Surface (ft)</th>
<th>Elev (ft)</th>
<th>Time (hours)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>105.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.5</td>
<td>101.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.0</td>
<td>95.50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Material Description**

- **Topsoil = 6"**
  - Red, orange, moist, loose SAND (SP), some Silt, Clay, little to some Gravel
  - Sample No. 1: 2-3-4-4  
    - BLOWS/RQD: 0.0-2.0
  - Sample No. 2: 4-4-6-8  
    - BLOWS/RQD: 2.0-4.0

- **Brown, tan, damp to very stiff lean CLAY (CL), little to trace Silt, trace Sand**
  - Sample No. 3: 3-3-5-8  
    - BLOWS/RQD: 4.0-6.0
  - Sample No. 4: 7-9-13-15  
    - BLOWS/RQD: 6.0-8.0
  - Sample No. 5: 6-8-10-13  
    - BLOWS/RQD: 8.0-10.0

**Remarks:**

- EL is approximated from Boring Plan provided

---

**Ground Surface Elevation:** 105.7 ft

---

**Bowie State University Parking Lot**

- **PI - Plasticity Index**
- **LL - Liquid Limit**
- **NMC - Natural Moisture Content**
- **RQD - Rock Quality Designation**
- **OD - Outside Diameter**
- **SPT - Standard Penetration Test**
- **REC - Recovery**

---

**Legend:**

- **NMC - Natural Moisture Content**
- **PI - Plasticity Index**
- **REC - Recovery**
- **MATL - Material Graphics**
- **SPT - Standard Penetration Test**
- **LL - Liquid Limit**
- **Elev - Elevation**
- **Geotech - Geotechnical**
- **OD - Outside Diameter**

---

**Sheet 1 of 1**  
**Boring 7 of 16**
**Contract No.:** 16-1037-01  
**Project Description:** Bowie State University Parking Lot

**Easting:** 1380683.99  
**Northing:** 493898.41

**Date Started:** 9/12/18  
**Date Completed:** 9/12/18

**Inspected by:** D. Tajhya  
**Logged by:** D. Fincham

---

### Water Table

<table>
<thead>
<tr>
<th>Depth Below Surface</th>
<th>Time (hours)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 0.0</td>
<td>END</td>
<td>9/12/18</td>
</tr>
<tr>
<td>&lt; 0.0</td>
<td></td>
<td>9/13/18</td>
</tr>
</tbody>
</table>

### Cave-In Table

<table>
<thead>
<tr>
<th>Depth Below Surface</th>
<th>Time (hours)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 0.0</td>
<td>END</td>
<td>9/12/18</td>
</tr>
<tr>
<td>&lt; 0.0</td>
<td></td>
<td>9/13/18</td>
</tr>
</tbody>
</table>

### Depth in Feet | Elev. in Feet | Material Description |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>102.20</td>
<td>Topsoil = 10&quot;</td>
</tr>
<tr>
<td>10.0</td>
<td>93.00</td>
<td>Bottom of Boring @ 12&quot;</td>
</tr>
<tr>
<td>12.0</td>
<td>91.00</td>
<td>Bottom of Boring @ 12&quot;</td>
</tr>
</tbody>
</table>

### Boring and Sampling

- **Date Started:** 9/12/18  
- **Date Completed:** 9/12/18

---

**Remarks:**
- **EL is approximated from Boring Plan provided.**
- **Bulk sample @ 1.0'-5.0'**

---

**Legend:**
- **NMC** - Natural Moisture Content  
- **PI** - Plasticity Index  
- **LL** - Liquid Limit  
- **REC** - Recovery  
- **RQD** - Rock Quality Designation  
- **MATL** - Material Graphics  
- **OD** - Outside Diameter  
- **SPT** - Standard Penetration Test  
- **SWM** - Standard Penetration Test (Spoon/rock core)
**BORING LOG**

**Contract No.:** 16-1037-01  
**Project Description:** Bowie State University Parking Lot

**Boring No.:** SWM-4  
**Station:** ,  
**Easting:** 1380877.72  
**Northing:** 494073.39  
**Ground Surface Elevation:** 107.5 ft

**Date Started:** 9/11/18  
**Date Completed:** 9/11/18

**Inspector:** D. Tajhya  
**Driller:** D. Fincham

---

**WATER TABLE**

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Elev (ft)</th>
<th>Time (hours)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.0</td>
<td>103.5</td>
<td>24 hrs</td>
<td>9/12/18</td>
</tr>
<tr>
<td>8.0</td>
<td>99.5</td>
<td>END</td>
<td>9/11/18</td>
</tr>
<tr>
<td>5.6</td>
<td>101.9</td>
<td>24 hrs</td>
<td>9/12/18</td>
</tr>
</tbody>
</table>

**CAVE-IN TABLE**

<table>
<thead>
<tr>
<th>Depth Below Surface</th>
<th>Time (hours)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>END</td>
<td>9/11/18</td>
</tr>
</tbody>
</table>

---

**DEPT IN FEET**

<table>
<thead>
<tr>
<th>MATL</th>
<th>MATERIAL DESCRIPTION</th>
<th>SPT SPOON/ROCK CORE</th>
<th>LAB. INDEX TESTS</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Topsoil = 12&quot;</td>
<td>22</td>
<td></td>
<td>EL is approximated from Boring Plan provided</td>
</tr>
<tr>
<td>2.0</td>
<td>Multi-colored, moist, loose, Silty Clayey SAND (SC-SM), trace Roots (FILL)</td>
<td>6</td>
<td></td>
<td>Water on Rod @ 4.8&quot;</td>
</tr>
<tr>
<td>5.5</td>
<td>Grey, brown, moist to wet, medium stiff CLAY (CL), little to some Gravel, little Silt, trace Roots, Wood (FILL)</td>
<td>24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.0</td>
<td>Brown, tan, red, damp, stiff, SILT (ML), little Clay, trace Sand</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bottom of Boring @ 10'</td>
<td>16</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Legend:**
- NMC - Natural Moisture Content  
- PI - Plasticity Index  
- REC - Recovery  
- MATL - Material Graphics  
- SPT - Standard Penetration Test  
- RQD - Rock Quality Designation  
- LL - Liquid Limit  
- Elev - Elevation  
- OD - Outside Diameter

---

**Notes:**
- Conforms to ASTM/AASHTO.
### Boring Log

**Contract No.:** 16-1037-01  
**Project Description:** Bowie State University Parking Lot

<table>
<thead>
<tr>
<th>Boring No.</th>
<th>Station</th>
<th>Ground Surface Elevation: 106.0 ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWM-5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Easting: 1381004.87 | Northing: 494084.46 |

<table>
<thead>
<tr>
<th>Date Started: 9/11/18</th>
<th>Date Completed: 9/11/18</th>
</tr>
</thead>
</table>

| Inspector: D. Tajhya | Driller: D. Fincham |

#### Water Table

<table>
<thead>
<tr>
<th>Depth Below Surface</th>
<th>Elev (ft)</th>
<th>Time (hours)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.9</td>
<td>101.1</td>
<td>END</td>
<td>9/11/18</td>
</tr>
<tr>
<td>3.9</td>
<td>102.1</td>
<td>24 hrs</td>
<td>9/12/18</td>
</tr>
</tbody>
</table>

#### Cave-In Table

<table>
<thead>
<tr>
<th>Depth Below Surface</th>
<th>Elev (ft)</th>
<th>Time (hours)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.4</td>
<td>100.6</td>
<td>END</td>
<td>9/11/18</td>
</tr>
<tr>
<td>5.2</td>
<td>100.8</td>
<td>24 hrs</td>
<td>9/12/18</td>
</tr>
</tbody>
</table>

#### Material Description

- **Topsoil = 9"**
  - Brown, damp, stiff SILT (ML), little Clay, Sand (FILL)

- **Brown, grey, moist, medium dense Silty SAND (SM), some Gravel, little Clay**

- **Red, brown, moist to wet, dense to medium dense SAND (SP) with Gravel, trace to little Silt**

- **Tan, red, brown, damp to moist, very stiff to stiff SILT (ML), little Clay, trace Sand**
  - Yellow, brown, tan, wet, dense SAND (SP), some Silt

- **Bottom of Boring @ 10'**

Legend:
- NMC - Natural Moisture Content
- PI - Plasticity Index
- REC - Recovery
- MATL - Material Graphics
- SPT - Standard Penetration Test
- RQD - Rock Quality Designation
- LL - Liquid Limit
- Elev - Elevation
- Elev - Geotechnical
- OD - Outside Diameter

Rig Type: Track 45  
Rig No.: R-3  
Drive Hammer Weight: 140 LB  
Auger Size: 3-1/4"  
Size of Core: IN  
Size of Bit OD: IN  
Hammer Energy Ratio: 10%  
Auger Depth: 10 FT

**Remarks:**
- EL is approximated from Boring Plan provided
- Water on Rod @ 5.5'

**Boring and Sampling:** Conforms to ASTM/AASHTO.
## Boring Log

**Contract No.:** 16-1037-01  
**Project Description:** Bowie State University Parking Lot

**Boring No.:** SWM-6  
**Station:**  
**Date Started:** 9/11/18  
**Date Completed:** 9/11/18  
**Logged by:** D. Tajhya

### Topsoil

- **Elev.** 106.80
- **Depth** 0.7 ft
- **Description:** Topsoil = 8”

### Water Table

- **Depth Below Surface**
  - 0.7 ft
  - 9/11/18
  - **Elev.** 106.80

### CAVE-IN TABLE

- **Sample No.**
  - 1
  - 2
  - 3
  - 4
  - 5

### LAB. INDEX TESTS

- **SPT:**
  - BLOWs/RQD
  - SPOON/ROCK CORE
- **Material Description:**
  - Light brown, tan, moist, stiff SILT (ML), little Sand, Clay
  - Bottom of Boring @ 10’

### Remarks

- **EL is approximated from Boring Plan provided**
- **Water on Rod @ 8’**
Boring Log

Contract No.: 16-1037-01  Project Description: Bowie State University Parking Lot

Boring No. SWM-7  Station: , '

Easting: 1380698.12  Northing: 493787.2

Date Started: 9/13/18  Date Completed: 9/13/18

Inspector: D. Tajhya  Driller: D. Fincham

Ground Surface Elevation: 114.0 ft

Logged by: D. Tajhya

Water Table

<table>
<thead>
<tr>
<th>Depth Below Surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth (ft)</td>
</tr>
<tr>
<td>0.8</td>
</tr>
<tr>
<td>2.0</td>
</tr>
<tr>
<td>4.0</td>
</tr>
</tbody>
</table>

Material Description:
- Topsoil = 10"
- Brown, damp, medium dense Silty SAND (SM), little Clay
- Red, brown, damp, loose SAND (SP), trace Silt, Gravel
- Multi-brown, moist to wet, loose to dense SAND with SILT (SP-SM), Gravel, little Clay
- Red, brown, damp, stiff SILT (ML), little Clay, trace Sand
- Bottom of Boring @ 10'
**FINDLING, INC.**

**BORING LOG**

Contract No.: 16-1037-01  
Project Description: Bowie State University Parking Lot

**Boring No.**  
SWM-8  
Station: ,

**Easting:**  
1380846.22  
**Northing:**  
493920.22

**Date Started:**  
9/13/18  
**Date Completed:**  
9/13/18

**Inspector:**  
D. Tajhya  
**Driller:**  
D. Fincham

---

**WATER TABLE**

<table>
<thead>
<tr>
<th>Depth Below Surface</th>
<th>Time (hours)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>9/13/18</td>
</tr>
</tbody>
</table>

**CAVE-IN TABLE**

<table>
<thead>
<tr>
<th>Depth Below Surface</th>
<th>Time (hours)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>9/13/18</td>
</tr>
</tbody>
</table>

**CLAY**

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Elev (ft)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.7</td>
<td>110.30</td>
<td>9/13/18</td>
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**SPOON/ROCK CORE**

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Blows/RQD</th>
<th>Sample Depth</th>
<th>REC. SPT(in) or Core (%)</th>
<th>LAB. INDEX TESTS</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3-3-4-4</td>
<td>0.0 - 2.0</td>
<td>16</td>
<td></td>
<td>EL is approximated from Boring Plan provided</td>
</tr>
</tbody>
</table>

**MATERIAL DESCRIPTION**

- **Topsoil with Cobble = 8"**
- **Grey, brown, moist, loose Silty Clayey SAND (SC-SM), little Gravel, trace Wood (FILL)**
- **Brown, moist to wet, medium dense Silty SAND (SM), little to some Gravel, little Clay (FILL)**
- **Red, tan, damp, stiff SILT (ML), little Clay, trace Sand**

**Bottom of Boring @ 10'**
**BORING LOG**

**Contract No.:** 16-1037-01  **Project Description:** Bowie State University Parking Lot

**Boring No.:** SWM-9  **Station:** , '

**Easting:** 1380781.01  **Northing:** 493736.93

**Date Started:** 9/17/18  **Date Completed:** 9/17/18

**Inspector:** D. Tajhya  **Driller:** D. Fincham

**Ground Surface Elevation:** 119.0 ft

**Logged by:** D. Tajhya

---

### WATER TABLE

<table>
<thead>
<tr>
<th>Depth Below Surface</th>
<th>Time (hours)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>118.50 ft</td>
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<td>9/17/18</td>
</tr>
<tr>
<td>24 hrs</td>
<td>9/18/18</td>
<td></td>
</tr>
</tbody>
</table>

### CAVE-IN TABLE

<table>
<thead>
<tr>
<th>Depth Below Surface</th>
<th>Time (hours)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.0</td>
<td>END</td>
<td>9/17/18</td>
</tr>
<tr>
<td>8.0</td>
<td>24 hrs</td>
<td>9/18/18</td>
</tr>
</tbody>
</table>

---

### DEPTH IN FEET  ELEV. IN FEET  MATL  MATERIAL DESCRIPTION

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Elev (ft)</th>
<th>Material Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>118.50</td>
<td>Topsoil = 6&quot;</td>
</tr>
<tr>
<td>2.0</td>
<td>117.00</td>
<td>Brown, moist, very loose, Silty SAND (SM), little Clay, Roots</td>
</tr>
<tr>
<td>4.0</td>
<td>115.00</td>
<td>Red, brown, moist, very loose, Silty SAND (SM), little Gravel, Clay</td>
</tr>
<tr>
<td>8.0</td>
<td>111.00</td>
<td>Red, brown, moist, little to some Gravel, trace Clay</td>
</tr>
<tr>
<td>10.0</td>
<td>109.00</td>
<td>Brown, moist, medium dense SAND (SP) with Gravel, trace Silt</td>
</tr>
</tbody>
</table>

**Bottom of Boring @ 10 ft**

---

### SPT SPOON/ROCK CORE

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>BLOWS/RQD</th>
<th>Sample Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1-1-1</td>
<td>0.0-2.0</td>
</tr>
<tr>
<td>2</td>
<td>WOH-1-2-4</td>
<td>2.0-4.0</td>
</tr>
<tr>
<td>3</td>
<td>3-3-3</td>
<td>4.0-6.0</td>
</tr>
<tr>
<td>4</td>
<td>2-3-4-6</td>
<td>6.0-8.0</td>
</tr>
<tr>
<td>5</td>
<td>4-5-8-7</td>
<td>8.0-10.0</td>
</tr>
</tbody>
</table>

**REMARKS**

- EL is approximated from Boring Plan provided
- Bulk sample @ 1.0'-5.0'

---

**LAB. INDEX TESTS**

- **NMC (%):**
- **LL (%):**
- **PI (%):**

**REMKS**

- Conforms to ASTM/AASHTO:

---

**Legend:**

- NMC - Natural Moisture Content
- PI - Plasticity Index
- REC - Recovery
- MATL - Material Graphics
- SPT - Standard Penetration Test
- RQD - Rock Quality Designation
- LL - Liquid Limit
- Elev - Elevation
- Geotech - Geotechnical
- OD - Outside Diameter

---

**Boring and Sampling**

- Conforms to ASTM/AASHTO
Contract No.: 16-1037-01  
Project Description: Bowie State University Parking Lot

Boring No.: SWM-10  
Station:  
Easting: 1380857.04  
Northing: 493831.02  
Date Started: 9/17/18  
Date Completed: 9/17/18  
Inspector: D. Tajhya  
Driller: D. Fincham

Ground Surface Elevation: 117.4 ft

Logged by: D. Tajhya

---

**Depth Below Surface**

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Elev (ft)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3</td>
<td>117.20</td>
<td>END 9/17/18</td>
</tr>
<tr>
<td>2.5</td>
<td>115.00</td>
<td>24 hrs 9/18/18</td>
</tr>
<tr>
<td>10.0</td>
<td>107.50</td>
<td>END 9/17/18</td>
</tr>
</tbody>
</table>

**MATERIAL DESCRIPTION**

1. **Topsoil = 4"**
   - Brown, moist, very loose SAND (SP), some Silt, trace Gravel, Roots

2. **Red, brown, damp, medium dense to dense SAND with SILT (SP-SM) with Gravel, trace Clay**

3. **Bottom of Boring @ 10 ft**

---

**WATER TABLE**

<table>
<thead>
<tr>
<th>Depth Below Surface</th>
<th>Time (hours)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>END</td>
<td></td>
<td>9/17/18</td>
</tr>
<tr>
<td>24 hrs</td>
<td></td>
<td>9/18/18</td>
</tr>
</tbody>
</table>

**CAVE-IN TABLE**

<table>
<thead>
<tr>
<th>Rig Type</th>
<th>Track 45</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rig No.</td>
<td>R-3</td>
</tr>
<tr>
<td>Drive Hammer Weight</td>
<td>140 LB</td>
</tr>
<tr>
<td>Auger Size</td>
<td>3-1/4 IN</td>
</tr>
<tr>
<td>Size of Core</td>
<td>IN</td>
</tr>
<tr>
<td>Size of Bit OD</td>
<td>IN</td>
</tr>
<tr>
<td>Hammer Energy Ratio</td>
<td>%</td>
</tr>
<tr>
<td>Auger Depth</td>
<td>10 FT</td>
</tr>
</tbody>
</table>

---

**SPT SPOON/ROCK CORE**

<table>
<thead>
<tr>
<th>SAMPLE NO.</th>
<th>BLOWS/RQD</th>
<th>SAMPLE DEPTH</th>
<th>REC. SPT(in) or Core (%)</th>
<th>LAB. INDEX TESTS</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1-1-2-1</td>
<td>0.0-2.0</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3-7-11-15</td>
<td>2.0-4.0</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>10-15-15-12</td>
<td>4.0-6.0</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>7-14-13-16</td>
<td>6.0-8.0</td>
<td>24</td>
<td></td>
<td></td>
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<tr>
<td>5</td>
<td>10-15-18-18</td>
<td>8.0-10.0</td>
<td>24</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**REMARKS**

EL is approximated from Boring Plan provided.
# BORING LOG

**Contract No.:** 16-1037-01  
**Project Description:** Bowie State University Parking Lot  
**Boring No.:** SWM-11  
**Station:**  
**Easting:** 1380965.97  
**Northing:** 493868.17  
**Date Started:** 9/13/18  
**Date Completed:** 9/13/18  
**Inspector:** D. Tajhya  
**Driller:** D. Fincham  
**Logged by:** D. Tajhya

## WATER TABLE

<table>
<thead>
<tr>
<th>Depth Below Surface</th>
<th>Time</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>END</td>
<td>24 hrs</td>
<td>9/14/18</td>
</tr>
</tbody>
</table>

## CAVE-IN TABLE

<table>
<thead>
<tr>
<th>Rig Type</th>
<th>Track 45</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rig No.</td>
<td>R-3</td>
</tr>
<tr>
<td>Drive Hammer Weight</td>
<td>140 LB</td>
</tr>
<tr>
<td>Auger Size</td>
<td>3-1/4 IN</td>
</tr>
<tr>
<td>Size of Core</td>
<td>IN</td>
</tr>
<tr>
<td>Size of Bit OD</td>
<td>IN</td>
</tr>
<tr>
<td>Hammer Energy Ratio</td>
<td>%</td>
</tr>
<tr>
<td>Auger Depth</td>
<td>10 FT</td>
</tr>
</tbody>
</table>

## DEPTH IN FEET  | ELEV. IN FEET  | MATL  | MATERIAL DESCRIPTION  | SPT SPOON/ROCK CORE | REC. % | LAB. INDEX TESTS |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3</td>
<td>117.20</td>
<td></td>
<td>Topsoil = 4&quot; Brown, moist, very loose SAND (SP), little Silt, Clay</td>
<td>1 2-2-1-2 0.0-2.0</td>
<td>20</td>
<td>NMC (%)</td>
</tr>
<tr>
<td>2.5</td>
<td>115.00</td>
<td></td>
<td>Brown, damp to moist, medium dense to dense to medium dense Silty SAND and Gravel (SW-SM), trace Clay</td>
<td>2 3-9-12-12 2.0-4.0</td>
<td>20</td>
<td>LL (%)</td>
</tr>
<tr>
<td>10.0</td>
<td>107.50</td>
<td></td>
<td>Bottom of Boring @ 10'</td>
<td>3 8-14-13-10 4.0-6.0</td>
<td>24</td>
<td>PI (%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4 5-8-11-13 6.0-8.0</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5 7-10-13-15 8.0-10.0</td>
<td>22</td>
<td></td>
</tr>
</tbody>
</table>

## REMARKS

- **EL** is approximated from Boring Plan provided
- Bulk sample @ 1.0'-5.0'

---

**Legend:**

- **NMC** - Natural Moisture Content
- **PI** - Plasticity Index
- **REC** - Recovery
- **MATL** - Material Graphics
- **SPT** - Standard Penetration Test

**CONFORMS TO ASTM/AASHTO:**

- **RQD** - Rock Quality Designation
- **LL** - Liquid Limit
- **Elev** - Elevation
- **Geotech** - Geotechnical
- **OD** - Outside Diameter

16-1037-01 WBCM BOWIE STATE UNIVERSITY PARKING LOT GPJ-10/15/18

- Boring and Sampling
- Conforms to ASTM/AASHTO
### Subject Quadrangle:

<table>
<thead>
<tr>
<th>Subject Name: Bowie State Univ Parking Lot</th>
<th>Report Date: 10/11/2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address: Jericho Park Rd, Bowie, MD 20715</td>
<td></td>
</tr>
<tr>
<td>Lat/Long: 39.022305 / -76.758743</td>
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</tr>
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</table>

#### Subject Quad:

<table>
<thead>
<tr>
<th>Map Name:</th>
<th>Map Year:</th>
<th>Revision Year:</th>
<th>Scale:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1894</td>
<td>N/R</td>
<td>1:62500</td>
<td>Part 1</td>
</tr>
</tbody>
</table>

**Series: 7.5**

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![Topographic Map](image)
SECTION 321216 - 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. Section Includes:
   1. Hot-mix asphalt patching.
   2. Hot-mix asphalt paving.
   3. Hot-mix asphalt overlay.

B. Related Requirements:
   1. Section 024116 "Structure Demolition" and Section 024119 "Selective Demolition" for demolition and removal of existing asphalt pavement.
   2. Section 312000 "Earth Moving" for subgrade preparation, fill material, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.
   3. Section 321373 "Concrete Paving Joint Sealants" for joint sealants and fillers at pavement terminations.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:
      a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
      b. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.

1.4 ACTION SUBMITTALS

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

B. Sustainable Design Submittals:
   1. Aggregate Tests
   2. Asphalt Cement Binder Certification
C. Samples for Verification: For the following product, in manufacturer's standard sizes unless otherwise indicated:
   1. Paving Fabric: 12 by 12 inches minimum.

### 1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and testing agency.

B. Material Certificates: For each paving material. Include statement that mixes containing recycled materials will perform equal to mixes produced from all new materials.

C. Material Test Reports: For each paving material, by a qualified testing agency.

D. Field quality-control reports.

### 1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by the Maryland State Highway Administration (MSHA).

B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of MSHA Standard Specifications for asphalt paving work.
   1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

### 1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
   1. Tack Coat: Minimum surface temperature of 60 deg F.
   2. Slurry Coat: Comply with weather limitations in ASTM D 3910.
   3. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
   4. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

### PART 2 - PRODUCTS

#### 2.1 AGGREGATES

A. Coarse Aggregate – Coarse aggregate shall conform to Section 901 of the MSHA Specifications and AASHTO M323, as modified below:
B. Fine Aggregate – Fine aggregate shall consist of clean, sound, durable, angular shaped particles produced by crushing stone or gravel that meets the requirements for wear and soundness specified for coarse aggregate. Natural (non-manufactured) siliceous sand may be used to obtain the gradation of the aggregate blend or to improve the workability of the mix. The amount of sand to be added will be adjusted to produce mixtures conforming to requirements of this Specification. The fine aggregate shall not contain more than 15 percent natural sand by weight of total aggregates. The aggregate particles shall be free from coatings of clay, silt, or other objectionable matter and shall contain no clay balls. Fine aggregate shall conform to Section 901 of the MSHA Specifications and AASHTO M323, as modified below:

C.

<table>
<thead>
<tr>
<th>Test</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>LA Abrasion Wear</td>
<td>30%, maximum</td>
</tr>
<tr>
<td>(AASHTO T96, 500 revolutions)</td>
<td></td>
</tr>
<tr>
<td>Sodium Sulfate Soundness Loss</td>
<td>12%, maximum</td>
</tr>
<tr>
<td>(AASHTO T104, 5 cycles)</td>
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</tr>
<tr>
<td>Sand Equivalent</td>
<td>50%, minimum</td>
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<tr>
<td>(AASHTO T176)</td>
<td></td>
</tr>
<tr>
<td>Uncompacted Void Content</td>
<td>45%, minimum</td>
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<tr>
<td>(AASHTO T304, Method A)</td>
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<tr>
<td>Plasticity Index</td>
<td>Non-plastic</td>
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<tr>
<td>(AASHTO T90)</td>
<td></td>
</tr>
<tr>
<td>Liquid Limit</td>
<td>25, maximum</td>
</tr>
<tr>
<td>(AASHTO T89)</td>
<td></td>
</tr>
<tr>
<td>Deleterious Materials</td>
<td>2%, maximum</td>
</tr>
<tr>
<td>(AASHTO T112)</td>
<td></td>
</tr>
</tbody>
</table>

D. Aggregate Gradation

1. Superpave Gradations: Each gradation contains maximum and minimum control points. Job mix formula gradations must fall within control points for the specified nominal aggregate size. The combined aggregate shall conform to the gradation requirements as set forth in AASHTO M323 and tested in accordance with AASHTO T11 and T27. Gradation requirements 9.5 mm superpave surface course and 19.0 mm superpave base course in accordance with MD SHA Standard Specifications section 904.
2.2 ASPHALT MATERIALS

A. Asphalt Binder: AASHTO M 320, PG 64-22.

B. Tack Coat: AASHTO M 140 emulsified asphalt, or AASHTO M 208 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

2.3 AUXILIARY MATERIALS

A. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt pavement; reclaimed, unbound-aggregate base material; and recycled tires, asphalt shingles, or glass from sources and gradations that have performed satisfactorily in previous installations, equal to performance of required hot-mix asphalt paving produced from all new materials.

2.4 MIXES

A. Recycled Content of Hot-Mix Asphalt: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 percent or more than 25 percent by weight.
   1. Surface Course Limit: Recycled content no more than 10 percent by weight.

B. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes per AASHTO R35 and complying with the following requirements:
   1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
   2. Base Course: HMA Superpave 12.5 mm.
   3. Surface Course: HMA Superpave 9.5 mm.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
   1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
   2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
   3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by ENGINEER, and replace with compacted backfill or fill as directed.

C. Proceed with paving only after unsatisfactory conditions have been corrected.
3.2 PATCHING

A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into perimeter of 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 reseat concrete pieces firmly.
   1. Pump hot undersealing asphalt under rocking slab until slab is stabilized or, if necessary, crack slab into pieces and roll to reseat pieces firmly.
   2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.

C. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate 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. Placing Patch Material: 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.

3.3 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.

3.4 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
B. Tack Coat: Apply uniformly to surfaces of existing pavement 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.

3.5 PLACING HOT-MIX ASPHALT

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
   1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
   2. Place hot-mix asphalt surface course in single lift.
   3. Spread mix at a minimum temperature of 250 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. Overlap mix placement about 1 to 1-1/2 inches from strip to strip to ensure proper compaction of mix along longitudinal joints.
   2. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.6 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.
   1. Clean contact surfaces and apply tack coat to joints.
   2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
   3. Offset transverse joints, in successive courses, a minimum of 24 inches.
   4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."
   5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
   6. Compact asphalt at joints to a density within 2 percent of specified course density.
3.7 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 with 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: 96 percent of reference laboratory density according to ASTM D 6927 or AASHTO T 245, but not less than 94 percent or greater than 100 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.8 INSTALLATION TOLERANCES

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

B. Pavement 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 FIELD QUALITY CONTROL

A. Testing Agency: The Contractor shall engage a qualified testing agency to perform tests and inspections at no additional cost to the Owner.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. 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 according to ASTM D 1188 or ASTM D 2726.

a. 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.

3.10 WASTE HANDLING

A. General: Handle asphalt-paving waste according to approved waste management plan and in accordance with all applicable Federal, and State. Dispose of waste materials off-site.

END OF SECTION 321216
SECTION 321313 - 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. Section Includes Concrete Paving. Including the Following:
      1. Curbs and gutters.
      2. Walks.
   
   B. Related Requirements:
      1. Section 321373 "Concrete Paving Joint Sealants" for joint sealants in expansion and
         contraction joints within concrete paving and in joints between concrete paving and
         asphalt paving or adjacent construction.
      2. Section 321713 "Parking Bumpers."
      3. Section 321723 "Pavement Markings."
      4. Section 321726 "Tactile Warning Surfacing" for detectable warning tiles.

1.3 DEFINITIONS
   A. Cementitious Materials: Portland cement alone or in combination with one or more of blended
      hydraulic cement, fly ash, slag cement, and other pozzolans.
   
   B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS
   A. Preinstallation Conference: Conduct conference at Project site.
      1. Review methods and procedures related to concrete paving, including but not limited to,
         the following:
         a. Concrete mixture design.
         b. Quality control of concrete materials and concrete paving construction practices.
      2. Require representatives of each entity directly concerned with concrete paving to attend,
         including the following:
         a. Contractor's superintendent.
         b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Concrete paving Subcontractor.
e. Manufacturer's representative of stamped concrete paving system used for stamped detectable warnings.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color selection.

C. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified ready-mix concrete manufacturer and testing agency.

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

C. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Ready-Mix-Concrete 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" (Quality Control Manual - Section 3, "Plant Certification Checklist").

B. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
   1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

1.8 PRECONSTRUCTION TESTING
   A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on concrete paving mixtures.

1.9 FIELD CONDITIONS
   A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
   B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
      1. When air temperature has fallen to or is expected to fall below 40 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 design mixtures.
   C. Hot-Weather Concrete 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 in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
      2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
      3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL
   A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

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

2.3 STEEL REINFORCEMENT

A. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, fabricated from as-drawn steel wire into flat sheets.


C. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

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

E. Tie Bars: ASTM A 615/A 615M, Grade 60; deformed.

F. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

G. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

H. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

I. Zinc Repair Material: ASTM A 780/A 780M.

2.4 CONCRETE MATERIALS

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

1. Portland Cement: ASTM C 150/C 150M, gray portland cement Type I, Type II or Type I/II.
2. Fly Ash: ASTM C 618, Class C or Class F.
3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.

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

C. Air-Entraining Admixture: ASTM C 260/C 260M.

D. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
   1. Water-Reducing Admixture: ASTM 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.

E. Water: Potable and complying with ASTM C 94/C 94M.

2.5 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.

B. Moisture-Retaining Cover: ASTM 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.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

2.6 RELATED MATERIALS

A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber in preformed strips.

B. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

2.7 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to MD SHA Standard Specification #901A (ACI 301M), with the following properties:
   2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.50.
   4. Air Content: 5 - 8 percent plus or minus 1.5 percent.
B. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and MD SHA Standard Specification #902A. Furnish batch certificates for each batch discharged and used in the Work.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.
   1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
   2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
   3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Section 312000 "Earth Moving."

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

3.2 PREPARATION

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

3.3 EDGE FORMS AND SCREED CONSTRUCTION

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

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

3.4 STEEL REINFORCEMENT INSTALLATION

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.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
2. Provide tie bars at sides of paving strips where indicated.
3. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

1. Expansion joints are types of isolation joints. Revise spacing in first subparagraph below to suit Project or delete if not required.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
1. **Grooved Joints:** Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes.
   
a. **Tolerance:** Ensure that grooved joints are within 3 inches either way from centers of dowels.

2. **Sawed Joints:** Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
   
a. **Tolerance:** Ensure that sawed joints are within 3 inches either way from centers of dowels.

3. **Doweled Contraction Joints:** Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

E. **Edging:** After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes.

### 3.6 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. **Consolidate concrete** according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
   
1. **Consolidate concrete** along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, 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 paving surface** with a straightedge and strike off.
I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleedwater 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. 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.

3.8 DETECTABLE WARNING INSTALLATION

A. Cast-in-Place Detectable Warning Tiles: Form blockouts in concrete for installation of tiles specified in Section 321726 "Tactile Warning Surfacing." Screed surface of concrete where tiles are to be installed to elevation, so that edges of installed tiles will be flush with surrounding concrete paving. Embed tiles in fresh concrete to comply with Section 321726 "Tactile Warning Surfacing" immediately after screeding concrete surface.

3.9 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

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

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound or a combination of these as follows:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
a. Water.
b. Continuous water-fog spray.
c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period, using cover material and waterproof tape.

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

3.10 PAVING TOLERANCES

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

1. Elevation: 3/4 inch.
3. Surface: Gap below 10-feet-long; unleveled straightedge not to exceed 1/2 inch.
4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
5. Lateral Alignment and Spacing of Dowels: 1 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
8. Joint Spacing: 3 inches.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C 172/C 172M shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
   a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
2. Slump: ASTM 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.
3. Air Content: ASTM C 231/C 231M, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when it is 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 one specimen at seven days and two specimens at 28 days.

   a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

D. Test results shall be reported in writing to ENGINEER, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by ENGINEER 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 ENGINEER.

G. Concrete paving will be considered defective if it does not pass tests and inspections.

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

I. Prepare test and inspection reports.

3.12 REPAIR AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by ENGINEER.

B. Drill test cores, where directed by ENGINEER, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.
C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313
SECTION 321373 - 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. Section Includes:
      1. Cold-applied joint sealants.
      2. Hot-applied joint sealants.
      3. Cold-applied, fuel-resistant joint sealants.
      5. Joint-sealant backer materials.
      6. Primers.

1.3 PREINSTALLATION MEETINGS
   A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS
   A. Product Data: For each type of product.
   B. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
   C. Paving-Joint-Sealant Schedule: Include the following information:
      1. Joint-sealant application, joint location, and designation.
      2. Joint-sealant manufacturer and product name.

1.5 INFORMATIONAL SUBMITTALS
   A. Qualification Data: For Installer.
   B. Product Certificates: For each type of joint sealant and accessory.
1.6 QUALITY ASSURANCE
   A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
   B. Product Testing: Test joint sealants using a qualified testing agency.

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

PART 2 - PRODUCTS

2.1 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.

2.2 COLD-APPLIED JOINT SEALANTS
   A. Single-Component, Nonsag, Silicone Joint Sealant: ASTM D 5893/D 5893M, Type NS.
      1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
         a. Crafo Inc., an ERGON company; RoadSaver Silicone.
         b. Dow Corning Corporation; 888.
         c. Pecora Corporation; 301 NS.
   B. Single-Component, Self-Leveling, Silicone Joint Sealant: ASTM D 5893/D 5893M, Type SL.
      1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
         a. Crafo Inc., an ERGON company; RoadSaver Silicone SL.
         b. Dow Corning Corporation; 890-SL.
         c. Pecora Corporation; 300 SL.
C. Multicomponent, Nonsag, Urethane, Elastomeric Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Use T.

   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Meadows, W.R., Inc; Pourthane NS.

D. Single Component, Pourable, Urethane, Elastomeric Joint Sealant: ASTM C 920, Type S, Grade P, Class 25, for Use T.

   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Meadows, W.R., Inc; Pourthane SL.

E. Multicomponent, Pourable, Urethane, Elastomeric Joint Sealant: ASTM C 920, Type M, Grade P, Class 25, for Use T.

   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Pecora Corporation; Dynatred, Dynatrol II-SG or Urexpant NR-200.

2.3 HOT-APPLIED JOINT SEALANTS


   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Crafco Inc; Asphalt Rubber Plus Asphalt Rubber Plus Type 2 RoadSaver 203 RoadSaver 211 RoadSaver 515.
      b. Meadows, W.R., Inc; Sealtight 1190 Sealtight 164.
      c. Right Pointe; JTS Asphalt Rubber Modified 043.

B. Hot-Applied, Single-Component Joint Sealant: ASTM D 6690, Type I or Type II.

   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Crafco Inc; RoadSaver 201 RoadSaver 220 RoadSaver 221 RoadSaver 534.
      b. Right Pointe; JTS 3405 Parking Lot Sealant 007 JTS 3405 Rubber 009.

C. Hot-Applied, Single-Component Joint Sealant: ASTM D 6690, Type I, II, or III.

   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Crafco Inc; RoadSaver 222.
      b. Meadows, W.R., Inc; Sealtight 3405.
Bowie State University – Car Parking Lot

c. **Right Pointe:** JTS 3405 Regular 003 JTS 3405 Rubber 009.

D. Hot-Applied, Single-Component Joint Sealant: ASTM D 6690, Type IV.

1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. **Crafco Inc:** RoadSaver 231.
   b. **Meadows, W.R., Inc:** Sealtight 3405M.

2.4 JOINT-SEALANT BACKER MATERIALS

A. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

B. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D 5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.

C. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D 5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

2.5 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

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

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

3.2 PREPARATION

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

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

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

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

C. Install joint-sealant backings to support joint 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 joint-sealant backings.
2. Do not stretch, twist, puncture, or tear joint-sealant backings.
3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install joint sealants immediately following backing installation, using proven techniques that comply with the following:

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

E. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skimming or curing begins, tool sealants according to the following requirements 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 joint sealant from surfaces adjacent to joints.
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.

3.4 CLEANING AND PROTECTION

A. Clean off excess joint sealant as the Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.
B. 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 in repaired areas are indistinguishable from the original work.

3.5 PAVING-JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Joints within concrete paving.

1. Joint Location:
   a. Expansion and isolation joints in concrete paving.
   b. Contraction joints in concrete paving.
   c. Other joints as indicated.


B. Joint-Sealant Application: Joints within concrete paving and between concrete and asphalt paving.

1. Joint Location:
   a. Joints between concrete and asphalt paving.
   b. Joints between concrete curbs and asphalt paving.
   c. Other joints as indicated.


C. Joint-Sealant Application: Fuel-resistant joints within concrete paving.

1. Joint Location:
   a. Expansion and isolation joints in concrete paving.
   b. Contraction joints in concrete paving.
   c. Other joints as indicated.


END OF SECTION 321373
SECTION 321400 - UNIT 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. Section Includes:
      1. Concrete pavers set in aggregate setting beds.

1.3 PREINSTALLATION MEETINGS
   A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS
   A. Product Data: For materials other than water and aggregates.
   B. Product Data: For the following:
      1. Pavers.
      2. Edge restraints.
   C. Sieve Analyses: For aggregate setting-bed materials, according to ASTM C 136.
   D. Samples for Initial Selection: For each type of unit paver indicated.
   E. Samples for Verification: For full-size units of each type of unit paver indicated.
      1. Exposed edge restraints.

1.5 INFORMATIONAL SUBMITTALS
   A. Material Certificates: For unit pavers. Include statements of material properties indicating compliance with requirements, including compliance with standards. Provide for each type and size of unit.
   B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for unit pavers, indicating compliance with requirements.
      1. For solid interlocking paving units, include test data for freezing and thawing according to ASTM C 67.
1.6 DELIVERY, STORAGE, AND HANDLING

A. Store pavers on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

1.7 FIELD CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of unit paver, joint material, and setting material from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

2.2 CONCRETE PAVERS

A. Concrete Pavers: Solid interlocking paving units complying with ASTM C 936/C 936M and resistant to freezing and thawing when tested according to ASTM C 67, made from normal-weight aggregates. Pavers shall match Bowie State University campus standard paver model Traditional Prest Brick Paver as manufactured by Hanover ENGIENERural Products.

1. Thickness: 2-3/8 inches (60 mm).
2. Face Size and Shape: 4-by-8-inch (102-by-203-mm) rectangle.
3. Color: Shall be an equal mixture of three paver colors matching Bowie State University campus standards.
   a. Color 1 – Red Charcoal Blend (standard color)
   b. Color 2 – Matrix #B92157 (custom color)
   c. Color 3 - Matrix #B92289 (custom color)

2.3 CURBS AND EDGE RESTRAINTS

A. Steel Edge Restraints: Manufacturer's standard painted steel edging 4 inches (100 mm1/4 inch (6.4 mm) thick by 5 inches (125 mm) high with loops pressed from or welded to face to receive stakes at 36 inches (900 mm) o.c. and steel stakes 15 inches (380 mm) long for each loop.

B. Job-Built Concrete Edge Restraints: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mixed concrete with minimum 28-day compressive strength of 3000 psi (20 MPa).

2.4 ACCESSORIES

A. Cork Joint Filler: Preformed strips complying with ASTM D 1752, Type II.


2.5 AGGREGATE SETTING-BED MATERIALS

A. Graded Aggregate for Subbase: Sound, crushed stone or gravel complying with ASTM D 448 for Size No. 57.

B. Graded Aggregate for Base: Sound, crushed stone or gravel complying with ASTM D 448 for Size No. 8.

C. Sand for Leveling Course: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C 33/C 33M for fine aggregate.

D. Stone Screenings for Leveling Course: Sound stone screenings complying with ASTM D 448 for Size No. 10.

E. Sand for Joints: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing No. 16 (1.18-mm) sieve and no more than 10 percent passing No. 200 (0.075-mm) sieve.

1. Provide sand of color needed to produce required joint color.

F. 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. Apparent Opening Size: No. 60 (0.250-mm) sieve, maximum; ASTM D 4751.
3. Permittivity: 0.02 per second, minimum; ASTM D 4491.
4. UV Stability: 50 percent after 500 hours' exposure, ASTM D 4355.

G. Drainage Geotextile: Nonwoven needle-punched geotextile fabric, 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. Apparent Opening Size: No. 40 (0.425-mm) sieve, maximum; ASTM D 4751.
3. Permittivity: 0.5 per second, minimum; ASTM D 4491.
4. UV Stability: 50 percent after 500 hours' exposure, ASTM D 4355.

H. Herbicide: Commercial chemical for weed control, registered with the EPA. Provide in granular, liquid, or wettable powder form.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces indicated to receive unit paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Where unit paving is to be installed over waterproofing, examine waterproofing installation, with waterproofing Installer present, for protection from paving operations, including areas where waterproofing system is turned up or flashed against vertical surfaces.

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

3.2 PREPARATION

A. Remove substances from concrete substrates that could impair mortar bond, including curing and sealing compounds, form oil, and laitance.

B. Sweep concrete substrates to remove dirt, dust, debris, and loose particles.

C. Proof-roll prepared subgrade according to requirements in Section 312000 "Earth Moving" to identify soft pockets and areas of excess yielding. Proceed with unit paver installation only after deficient subgrades have been corrected and are ready to receive subbase and base course for unit pavers.

3.3 INSTALLATION, GENERAL

A. Do not use unit pavers with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in finished work.

B. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.

C. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.

1. For concrete pavers, a block splitter may be used.

D. Handle protective-coated brick pavers to prevent coated surfaces from contacting backs or edges of other units. If, despite these precautions, coating does contact bonding surfaces of brick, remove coating from bonding surfaces before setting brick.

E. Joint Pattern: Running bond.

F. Tolerances: Do not exceed 1/32-inch (0.8-mm) unit-to-unit offset from flush (lippage) or 1/8 inch in 10 feet (3 mm in 3 m) from level, or indicated slope, for finished surface of paving.
G. Expansion and Control Joints: Provide cork joint filler at locations and of widths indicated. Install joint filler before setting pavers. Make top of joint filler flush with top of pavers.

H. Provide edge restraints as indicated. Install edge restraints before placing unit pavers.
   1. Install edge restraints to comply with manufacturer's written instructions. Install stakes at intervals required to hold edge restraints in place during and after unit paver installation.
   2. For metal edge restraints with top edge exposed, drive stakes at least 1 inch (25 mm) below top edge.
   3. Install job-built concrete edge restraints to comply with requirements in Section 033000 "Cast-in-Place Concrete."

3.4 AGGREGATE SETTING-BED APPLICATIONS

   A. Compact soil subgrade uniformly to at least 95 percent of ASTM D 698 laboratory density.

   B. Proof-roll prepared subgrade to identify soft pockets and areas of excess yielding. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by ENGINEER, and replace with compacted backfill or fill as directed.

   C. Place separation geotextile over prepared subgrade, overlapping ends and edges at least 12 inches (300 mm).

   D. Place aggregate subbase and base, compact by tamping with plate vibrator, and screed to depth indicated.

   E. Place aggregate subbase and base, compact to 100 percent of ASTM D 1557 maximum laboratory density, and screed to depth indicated.

   F. Place drainage geotextile over compacted base course, overlapping ends and edges at least 12 inches (300 mm).

   G. Place leveling course and screed to a thickness of 1 to 1-1/2 inches (25 to 38 mm), taking care that moisture content remains constant and density is loose and uniform until pavers are set and compacted.

   H. Treat leveling course with herbicide to inhibit growth of grass and weeds.

   I. Set pavers with a minimum joint width of 1/16 inch (1.5 mm) and a maximum of 1/8 inch (3 mm), being careful not to disturb leveling base. If pavers have spacer bars, place pavers hand tight against spacer bars. Use string lines to keep straight lines. Fill gaps between units that exceed 3/8 inch (10 mm) with pieces cut to fit from full-size unit pavers.

       1. When installation is performed with mechanical equipment, use only unit pavers with spacer bars on sides of each unit.

   J. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a 3500- to 5000-lbf (16- to 22-kN) compaction force at 80 to 90 Hz. Use vibrator with neoprene mat on face of plate or other means as needed to prevent cracking and chipping of pavers. Perform at least three passes across paving with vibrator.
1. Compact pavers when there is sufficient surface to accommodate operation of vibrator, leaving at least 36 inches (900 mm) of uncompacted pavers adjacent to temporary edges.
2. Before ending each day's work, compact installed concrete pavers except for 36-inch (900-mm) width of uncompacted pavers adjacent to temporary edges (laying faces).
3. As work progresses to perimeter of installation, compact installed pavers that are adjacent to permanent edges unless they are within 36 inches (90 mm) of laying face.
4. Before ending each day's work and when rain interrupts work, cover pavers that have not been compacted and cover leveling course on which pavers have not been placed with nonstaining plastic sheets to protect them from rain.

K. Spread dry sand and fill joints immediately after vibrating pavers into leveling course. Vibrate pavers and add sand until joints are completely filled, then remove excess sand. Leave a slight surplus of sand on the surface for joint filling.

L. Do not allow traffic on installed pavers until sand has been vibrated into joints.

M. Repeat joint-filling process 30 days later.

3.5 REPAIRING, POINTING, AND CLEANING

A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

B. Pointing: During tooling of joints, enlarge voids or holes and completely fill with grout. Point joints at sealant joints to provide a neat, uniform appearance, properly prepared for sealant application.

C. Cleaning: Remove excess grout from exposed paver surfaces; wash and scrub clean.

1. Remove temporary protective coating as recommended by coating manufacturer and as acceptable to paver and grout manufacturers.
2. Do not allow protective coating to enter floor drains. Trap, collect, and remove coating material.

END OF SECTION 321400
SECTION 321713 - PARKING BUMPERS

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section includes wheel stops.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PARKING BUMPERS
   A. Concrete Wheel Stops: Precast, steel-reinforced, air-entrained concrete, 4000-psi minimum compressive strength, 6 inches high by 8 inches wide by 72 inches long. Provide chamfered corners, 2 transverse drainage slots on underside, and a minimum of two factory-formed or drilled vertical holes through wheel stop for anchoring to substrate.
      1. Surface Appearance: Free of pockets, sand streaks, honeycombs, and other obvious defects. Corners shall be uniform, straight, and sharp.
      2. Mounting Hardware: steel spike or dowel, 1/2-inch diameter, 30-inch minimum length.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify that pavement is in suitable condition to begin installation according to manufacturer's written instructions.
   B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION
   A. Install wheel stops according to manufacturer's written instructions unless otherwise indicated.
B. Install wheel stops in bed of adhesive before anchoring.

C. Securely anchor wheel stops to pavement with hardware in each preformed vertical hole in wheel stop as recommended in writing by manufacturer. Recess head of hardware beneath top of wheel stop.

END OF SECTION 321713
SECTION 321723 - PAVEMENT MARKINGS

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section includes painted markings applied to asphalt and concrete pavement.

1.3 PREINSTALLATION MEETINGS
   A. Preinstallation Conference: Conduct conference at Project site.
      1. Review methods and procedures related to marking pavement including, but not limited to, the following:
         a. Pavement aging period before application of pavement markings.
         b. Review requirements for protecting pavement markings, including restriction of traffic during installation period.

1.4 ACTION SUBMITTALS
   A. Product Data: For each type of product.
      1. Include technical data and tested physical and performance properties.
   B. Shop Drawings: For pavement markings.
      1. Indicate pavement markings, colors, lane separations, defined parking spaces, and dimensions to adjacent work.
      2. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.

1.5 FIELD CONDITIONS
   A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for alkyd materials, 55 deg F for water-based materials, and not exceeding 95 deg F.
PART 2 - PRODUCTS

2.1 PAVEMENT-MARKING PAINT

   A. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than 45 minutes.

      1. Color: As indicated on site details.

PART 3 - EXECUTION

3.1 EXAMINATION

   A. Verify that pavement is dry and in suitable condition to begin pavement marking according to manufacturer's written instructions.

   B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

3.2 PAVEMENT MARKING

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

   B. Allow paving to age for a minimum of 30 days before starting pavement marking.

   C. Sweep and clean surface to eliminate loose material and dust.

   D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

      1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to pavement. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.

3.3 PROTECTING AND CLEANING

   A. Protect pavement markings from damage and wear during remainder of construction period.

   B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 321723
SECTION 321726 - TACTILE WARNING SURFACING

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
B. Related Requirements:
   1. Section 321313 "Concrete Paving" for concrete walkways serving as substrates for tactile warning surfacing.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.

1.4 CLOSEOUT SUBMITTALS
A. Maintenance Data: For tactile warning surfacing, to include in maintenance manuals.

1.5 PREINSTALLATION MEETINGS
A. Preinstallation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS
A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.
B. Weather Limitations for Adhesive Application:
   1. Apply adhesive only when ambient temperature is above 50 deg F and when temperature has not been below 35 deg F for 12 hours immediately before application. Do not apply when substrate is wet or contains excess moisture.
C. Weather Limitations for Mortar and Grout:

2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602. Provide artificial shade and windbreaks, and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F and higher.
   a. When ambient temperature exceeds 100 deg F, or when wind velocity exceeds 8 mph and ambient temperature exceeds 90 deg F, set unit pavers within 1 minute of spreading setting-bed mortar.

PART 2 - PRODUCTS

2.1 TACTILE WARNING SURFACING, GENERAL

A. Accessibility Requirements: Comply with applicable provisions in the U.S. ENGINEERural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities for tactile warning surfaces.

1. For tactile warning surfaces composed of multiple units, provide units that when installed provide consistent side-to-side and end-to-end dome spacing that complies with requirements.

B. Source Limitations: Obtain each type of tactile warning surfacing, from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

2.2 DETECTABLE WARNING TILES

A. Cast-in-Place Detectable Warning Tiles: Accessible truncated-dome detectable warning tiles configured for setting flush in new concrete walkway surfaces, with slip-resistant surface treatment on domes and field of tile. To match existing campus standards.

3. Shapes and Sizes:
   a. Rectangular panel, 24 by 48 inches.
   b. Radius panel, nominal 24 inches deep by 10-foot outside radius.

4. Dome Spacing and Configuration: 1.67-inch spacing to 2.35-inch spacing, in square pattern.
5. Mounting:
   a. Permanently embedded detectable warning tile wet-set into freshly poured concrete.
B. Detectable Warning Surface in the City of Baltimore right-of-way: For curb ramps indicated on the drawings within the City of Baltimore right-of-way in accordance with Baltimore City DOT standards detectable warning surfaces shall be in accordance with Standard No. BC 655.40.

2.3 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of tactile warning surfaces, noncorrosive and compatible with each material joined, and complying with the following:

1. Furnish Type 304 stainless-steel fasteners for exterior use.
2. Fastener Heads: For nonstructural connections, use flathead or oval countersunk screws and bolts with tamper-resistant heads, colored to match tile.

B. Adhesive: As recommended by manufacturer for adhering tactile warning surfacing unit to pavement.

C. Sealant: As recommended by manufacturer for sealing perimeter of tactile warning surfacing unit.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that pavement is in suitable condition to begin installation according to manufacturer's written instructions. Verify that installation of tactile warning surfacing will comply with accessibility requirements upon completion.

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

3.2 INSTALLATION OF TACTILE WARNING SURFACING

A. General: Prepare substrate and install tactile warning surfacing according to manufacturer's written instructions unless otherwise indicated.

B. Place tactile warning surfacing units in dimensions and orientation indicated. Comply with location requirements of AASHTO MP 12.

3.3 INSTALLATION OF DETECTABLE WARNING TILES

A. Cast-in-Place Detectable Warning Tiles:

1. Concrete Paving Installation: Comply with installation requirements in Section 321313 "Concrete Paving." Mix, place, and finish concrete to conditions complying with detectable warning tile manufacturer's written requirements for satisfactory embedment of tile.
2. Set each detectable warning tile accurately and firmly in place and completely seat tile back and embedments in wet concrete by tamping or vibrating. If necessary, temporarily apply weight to tiles to ensure full contact with concrete.

3. Set surface of tile flush with surrounding concrete and adjacent tiles, with variations between tiles and between concrete and tiles not exceeding plus or minus 1/8 inch from flush.

4. Protect exposed surfaces of installed tiles from contact with wet concrete. Complete finishing of concrete paving surrounding tiles. Remove concrete from tile surfaces.

5. Clean tiles using methods recommended in writing by manufacturer.

3.4 CLEANING AND PROTECTION

A. Remove and replace tactile warning surfacing that is broken or damaged or does not comply with requirements in this Section. Remove in complete sections from joint to joint unless otherwise approved by ENGINEER. Replace using tactile warning surfacing installation methods acceptable to ENGINEER.

B. Protect tactile warning surfacing from damage and maintain free of stains, discoloration, dirt, and other foreign material.

END OF SECTION 321726
SECTION 329115 - SOIL PREPARATION (PERFORMANCE SPECIFICATION)

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section includes planting soils specified according to performance requirements of the mixes. These section is not applicable to planting(s) that occur inside the filter area(s) of stormwater management facilities as indicated on the drawings.

B. Related Requirements:
   1. Section 311000 "Site Clearing" for topsoil stripping and stockpiling.
   2. Section 329200 "Turf and Grasses" for placing planting soil for turf and grasses.
   3. Section 329300 "Plants" for placing planting soil for plantings.

1.3 DEFINITIONS

B. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.

C. CEC: Cation exchange capacity.

D. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.

E. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.

F. Imported Soil: Soil that is transported to Project site for use.

G. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.

H. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of analytical data.
I. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."

J. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.


L. SSSA: Soil Science Society of America.

M. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

N. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

O. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.

P. USCC: U.S. Composting Council.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include recommendations for application and use.
2. Include test data substantiating that products comply with requirements.
3. Include sieve analyses for aggregate materials.
4. Material Certificates: For each type of imported soil and soil amendment and fertilizer before delivery to the site, according to the following:
   a. Manufacturer's qualified testing agency's certified analysis of standard products.
   b. Analysis of fertilizers, by a qualified testing agency, made according to AAPFCO methods for testing and labeling and according to AAPFCO's SUIP #25.
   c. Analysis of nonstandard materials, by a qualified testing agency, made according to SSSA methods, where applicable.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For each testing agency.

B. Preconstruction Test Reports: For preconstruction soil analyses specified in "Preconstruction Testing" Article.

C. Field quality-control reports.
1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.
1. Multiple Laboratories: At Contractor's option, work may be divided among qualified testing laboratories specializing in physical testing, chemical testing, and fertility testing.

1.7 SOIL-SAMPLING REQUIREMENTS

A. General: Extract soil samples according to requirements in this article.

B. Sample Collection and Labeling: Have samples taken and labeled by soil scientist (RPSS) registered by the National Society of Consulting Soil Scientists or state-certified, -licensed, or -registered soil scientist under the direction of the testing agency.
1. Number and Location of Samples: Minimum of three representative soil samples from varied locations for each soil to be used or amended for landscaping purposes.
2. Procedures and Depth of Samples: According to USDA-NRCS's "Field Book for Describing and Sampling Soils."
3. Division of Samples: Split each sample into two, equal parts. Send half to the testing agency and half to Owner for its records.
4. Labeling: Label each sample with the date, location keyed to a site plan or other location system, visible soil condition, and sampling depth.

1.8 TESTING REQUIREMENTS

A. General: Perform tests on soil samples for existing on site top-soil and soils to be re-used as planting soils according to requirements in this article.

B. Physical Testing:
1. Soil Texture: Soil-particle, size-distribution analysis by one of the following methods according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods":
   a. Sieving Method: Report sand-gradation percentages for very coarse, coarse, medium, fine, and very fine sand; and fragment-gradation (gravel) percentages for fine, medium, and coarse fragments; according to USDA sand and fragment sizes.

C. Fertility Testing: Soil fertility analysis according to standard laboratory protocol of SSSA NAPT NCR-13 including the following:
1. Percentage of organic matter.
2. CEC, calcium percent of CEC, and magnesium percent of CEC.
3. Soil reaction (acidity/alkalinity pH value).
4. Buffered acidity or alkalinity.
6. Phosphorous ppm.
7. Potassium ppm.
8. Manganese ppm.
10. Zinc ppm.
11. Zinc availability ppm.
12. Copper ppm.
13. Sodium ppm.
15. Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problem materials are present, provide additional recommendations for corrective action.
16. Other deleterious materials, including their characteristics and content of each.


E. Recommendations: Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants indicated. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients.
1. Fertilizers and Soil Amendment Rates: State recommendations in weight per 1000 sq. ft. (100 sq. m) for 6-inch (150-mm) depth of soil.
2. Soil Reaction: State the recommended liming rates for raising pH or sulfur for lowering pH according to the buffered acidity or buffered alkalinity in weight per 1000 sq. ft. (100 sq. m) for 6-inch (150-mm) depth of soil.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.

B. Bulk Materials:
1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Do not move or handle materials when they are wet or frozen.
4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

PART 2 - PRODUCTS

2.1 PLANTING SOILS SPECIFIED ACCORDING TO PERFORMANCE REQUIREMENTS

A. Planting-Soil: Existing, on-site surface soil, with the duff layer, if any, retained; and stockpiled on-site; modified to produce viable planting soil. Using preconstruction soil analyses and materials specified in other articles of this Section, amend existing, on-site surface soil to become planting soil complying with the following requirements:
2. Soil Reaction: pH of 5.5 to 7.
3. CEC of Total Soil: Minimum 7 meq/100 mL at pH of 7.0.
4. Soluble-Salt Content: 5 to 10 dS/m measured by electrical conductivity.
5. RCRA Metals: Below maximum limits established by the EPA.
6. Phytotoxicity: Below phytotoxicity limits established by SSSA.

2.2 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent.

B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a No. 6 sieve and a maximum of 10 percent passing through a No. 40 sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through a No. 50 sieve.

E. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to ASTM C 33/C 33M.

2.3 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance," and as follows:
   1. Feedstock: Limited to leaves.
   2. Reaction: pH of 5.5 to 8.
   3. Soluble-Salt Concentration: Less than 4 dS/m.
   4. Moisture Content: 35 to 55 percent by weight.
   5. Organic-Matter Content: 30 to 40 percent of dry weight.
   6. Particle Size: Minimum of 98 percent passing through a 2-inch sieve.

B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture, a pH of 3.4 to 4.8, and a soluble-salt content measured by electrical conductivity of maximum 5 dS/m.

C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, a pH of 6 to 7.5, a soluble-salt content measured by electrical conductivity of maximum 5 dS/m, having a water-absorbing capacity of 1100 to 2000 percent, and containing no sand.

D. Wood Derivatives: Shredded and composted, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.

E. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.
2.4 FERTILIZERS

A. Superphosphate: Commercial, phosphate mixture, soluble.

B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium.

C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium.

PART 3 - EXECUTION

A. Place planting soil and fertilizers according to requirements in other Specification Sections.

B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.

3.2 PREPARATION OF UNAMENDED, ON-SITE SOIL BEFORE AMENDING

A. Unacceptable Materials: Clean soil of concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.

B. Unsuitable Materials: Clean soil to contain a combined maximum of 5 percent by dry weight of stones, roots, plants, sod, clay lumps, and pockets of coarse sand.

C. Screening: Pass unamended soil through a 2-inch sieve to remove large materials.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Soil will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

D. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

3.4 PROTECTION AND CLEANING

A. Protection Zone: Identify protection zones according to Section 015639 "Temporary Tree and Plant Protection."
B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:
   1. Storage of construction materials, debris, or excavated material.
   2. Parking vehicles or equipment.
   3. Vehicle traffic.
   4. Foot traffic.
   5. Erection of sheds or structures.
   6. Impoundment of water.
   7. Excavation or other digging unless otherwise indicated.

C. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.
   1. Dispose of excess subsoil and unsuitable materials on-site where directed by Owner.

END OF SECTION 329115
SECTION 329200 - TURF AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Seeding.
   2. Hydroseeding.
   3. Erosion-control material(s).

B. Related Requirements:
   1. Section 329300 "Plants" for trees, shrubs, ground covers, and other plants as well as border edgings and mow strips.

1.3 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and mollusccides. They also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329115 "Soil Preparation (Performance Specification)" and drawing designations for planting soils.

E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For landscape Installer.

B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

1. Certification of each seed mixture for turfgrass sod. Include identification of source and name and telephone number of supplier.

C. Product Certificates: For fertilizers, from manufacturer.

D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required maintenance periods.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.

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 turf installation in addition to requirements in Section 014000 "Quality Requirements."

3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:
   a. Landscape Industry Certified Technician - Exterior.
   b. Landscape Industry Certified Lawncare Manager.
   c. Landscape Industry Certified Lawncare Technician.

5. Pesticide Applicator: State licensed, commercial.

1.8 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 compliance with state and Federal laws, as applicable.
B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.

C. Bulk Materials:
1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

1.9 FIELD 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 planting completion.
   1. Spring Planting: March 15 to June 15.
   2. Fall Planting: September 15 to November 15.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Species:
   1. Quality: State-certified seed of grass species composed of not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed. Species shall be an approved single species or species mix selected from Maryland Turfgrass Council Publication TT-77 "Recommended Turfgrass Cultivars for Certified Sod and Professional Seed Mixtures," most recent edition, or most recent version. Modify mix or utilize different mixtures for areas with significant solar exposure differences.

2.1 TURFGRASS SOD

A. Turfgrass Sod: Certified complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform
density, color, and texture that is strongly rooted and capable of vigorous growth and
development when planted.

B. Turfgrass Species: Sod of grass species as follows, quality: State-certified seed of grass
species composed of not less than 95 percent germination, not less than 85 percent pure
seed, and not more than 0.5 percent weed seed. Species shall be an approved single
species or species mix selected from Maryland Turfgrass Council Publication TT-77
“Recommended Turfgrass Cultivars for Certified Sod and Professional Seed Mixtures,”
most recent edition, or most recent version.

2.2 FERTILIZERS

A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character,
consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic
sources of urea formaldehyde, phosphorous, and potassium in the following
composition:
1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2
   percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in
   soil reports from a qualified soil-testing laboratory.

B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-
insoluble nitrogen, phosphorus, and potassium in the following composition:
1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent
   potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in
   soil reports from a qualified soil-testing laboratory.

2.3 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw
of wheat, rye, oats, or barley.

B. Sphagnum Peat Mulch: Partially decomposed sphagnum peat moss, finely divided or of
granular texture, and with a pH range of 3.4 to 4.8.

C. Muck Peat Mulch: Partially decomposed moss peat, native peat, or reed-sedge peat,
finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-
absorbing capacity of 1100 to 2000 percent, and containing no sand.

D. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of
5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-
inch sieve; soluble salt content of 2 to 5 decisiemens/m; not exceeding 0.5 percent inert
contaminants and free of substances toxic to plantings; and as follows:
1. Organic Matter Content: 50 to 60 percent of dry weight.
2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings;
or source-separated or compostable mixed solid waste.
E. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.

F. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

2.4 PESTICIDES

A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.5 EROSION-CONTROL MATERIALS

A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches long.

B. Erosion-Control Fiber Mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb/sq. yd., with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches long.

C. Erosion-Control Mats: Cellular, nonbiodegradable slope-stabilization mats designed to isolate and contain small areas of soil over steeply sloped surface, of 3-inch nominal mat thickness. Include manufacturer's recommended anchorage system for slope conditions.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Invisible Structures, Inc.
      b. Presto Products Company.
      c. Tenax Corporation - USA.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.
1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
3. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by ENGINEER and replace with new planting soil.

3.2 PREPARATION
A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
   1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
   2. Protect grade stakes set by others until directed to remove them.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 TURF AREA PREPARATION
A. General: Prepare planting area for soil placement and mix planting soil according to Section 329115 "Soil Preparation (Performance Specification)."
B. Placing Planting Soil: Place and mix planting soil in place over exposed subgrade.
   1. Reduce elevation of planting soil to allow for soil thickness of sod.
C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
D. Before planting, obtain ENGINEER's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 PREPARATION FOR EROSION-CONTROL MATERIALS
A. Prepare area as specified in "Turf Area Preparation" Article.
B. For erosion-control mats, install planting soil in two lifts, with second lift equal to thickness of erosion-control mats. Install erosion-control mat and fasten as recommended by material manufacturer.
C. Fill cells of erosion-control mat with planting soil and compact before planting.
D. For erosion-control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.

E. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.5 SEEDING

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph.
   1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
   2. Do not use wet seed or seed that is moldy or otherwise damaged.
   3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

B. Sow seed at a total rate of 3 to 4 lb/1000 sq. ft..

C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.

D. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets installed and stapled according to manufacturer's written instructions.

E. Protect seeded areas with erosion-control mats where indicated on Drawings; install and anchor according to manufacturer's written instructions.

F. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.
   1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.

3.6 HYDROSEEDING

A. Hydroseeding: Mix specified seed, commercial fertilizer slow-release fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
   1. Mix slurry with fiber-mulch manufacturer's recommended tackifier.
   2. Spray-apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than 1500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate.

3.1 SODDING

A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.
B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to soil or sod during installation. Tamp and roll lightly to ensure contact with soil, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

1. Lay sod across slopes exceeding 1:3.
2. Anchor sod on slopes exceeding 1:6 with wood pegs or steel staples spaced as recommended by sod manufacturer but not less than two anchors per sod strip to prevent slippage.

C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

3.2 TURF MAINTENANCE

A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.

C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

1. Mow turf-type tall fescue to a height of 2 to 3 inches.

D. Turf Post fertilization: Apply slow-release fertilizer after initial mowing and when grass is dry.

1. Use fertilizer that provides actual nitrogen of at least 1 lb/1000 sq. ft. to turf area.
3.3 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by ENGINEER:
   1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.
   2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.

B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

3.4 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.5 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

D. Remove nondegradable erosion-control measures after grass establishment period.

END OF SECTION 329200
SECTION 329300 - PLANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Plants.
   2. Tree stabilization.

1.3 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with a ball size not less than sizes indicated; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.

C. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than sizes indicated.

D. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than the minimum root spread according to ANSI Z60.1 for type and size of plant required.

E. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

F. Finish Grade: Elevation of finished surface of planting soil.

G. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.
H. **Pests:** Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

I. **Planting Area:** Areas to be planted.

J. **Planting Soil:** Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329115 "Soil Preparation (Performance Specification)" for drawing designations for planting soils.

K. **Plant; Plants; Plant Material:** These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

L. **Root Flare:** Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

M. **Stem Girdling Roots:** Roots that encircle the stems (trunks) of trees below the soil surface.

N. **Subgrade:** The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 **COORDINATION**

A. **Coordination with Turf Areas (Lawns):** Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.
   1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.5 **PREINSTALLATION MEETINGS**

A. **Preinstallation Conference:** Conduct conference at Project site.

1.6 **ACTION SUBMITTALS**

A. **Product Data:** For each type of product.
   1. **Plant Materials:** Include quantities, sizes, quality, and sources for plant materials.

1.7 **INFORMATIONAL SUBMITTALS**

A. **Product Certificates:** For each type of manufactured product, from manufacturer, and complying with the following:
   1. Manufacturer's certified analysis of standard products.
2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

B. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

C. Sample Warranty: For special warranty.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before expiration of required maintenance periods.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.
   1. Experience: Three years' experience in landscape installation in addition to requirements in Section 014000 "Quality Requirements."
   2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.
   1. Selection of plants purchased under allowances is made by ENGINEER, who tags plants at their place of growth before they are prepared for transplanting.

C. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.
   1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
   2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

D. Plant Material Observation: ENGINEER 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. ENGINEER may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
   1. Notify ENGINEER of sources of planting materials seven days in advance of delivery to site.
1.10 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.

B. Bulk Materials:
   1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
   2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
   3. Accompany each delivery of bulk materials with appropriate certificates.

C. Deliver bare-root stock plants within 24 hours of digging. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting. Transport in covered, temperature-controlled vehicles, and keep plants cool and protected from sun and wind at all times.

D. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

E. Handle planting stock by root ball.

F. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F until planting.

G. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
   1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

H. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

I. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

J.  
   1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
   2. Do not remove container-grown stock from containers before time of planting.
   3. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.
1.11 FIELD CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.
   1. Spring Planting: March 15th to June 15th.
   2. Fall Planting: September 15th to November 15th.

C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

1.12 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
      b. Structural failures including plantings falling or blowing over.
      c. Faulty performance of tree stabilization.
   2. Warranty Periods: From date of planting completion.
      a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
      b. Ground Covers, Biennials, Perennials, and Other Plants: Six months.
      c. Annuals: Three months.
   3. Include the following remedial actions as a minimum:
      a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
      b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
      c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.
      d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully...
branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk (“included bark”); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots are unacceptable.

2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to ENGINEER, with a proportionate increase in size of roots or balls.

C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

D. Labeling: Label at least one plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant.

2.2 FERTILIZERS

A. Planting Tablets: Tightly compressed chip-type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.

1. Size: 5-gram tablets.

2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

2.3 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Type: Shredded hardwood.

2. Size Range: 3 inches maximum, 1/2 inch minimum.


2.4 WEED-CONTROL BARRIERS

A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. minimum, composed of fibers formed into a stable network so that fibers retain their relative position. Fabric shall be inert to biological degradation and resist naturally encountered chemicals, alkalis, and acids.
B. Composite Fabric: Woven, needle-punched polypropylene substrate bonded to a nonwoven polypropylene fabric, 4.8 oz./sq. yd..

2.5 PESTICIDES

A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.6 TREE-STABILIZATION MATERIALS

A. Trunk-Stabilization Materials:
1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated, pointed at one end.
2. Flexible Ties: Wide rubber or elastic bands or straps of length required to reach stakes or turnbuckles.
5. Flags: Standard surveyor's plastic flagging tape, white, 6 inches long.

2.7 MISCELLANEOUS PRODUCTS

A. Wood Pressure-Preservative Treatment: AWPA U1, Use Category UC4a; acceptable to authorities having jurisdiction, and containing no arsenic or chromium.

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.

D. Planter Drainage Gravel: Washed, sound crushed stone or gravel complying with ASTM D 448 for Size No. 8.

E. Planter Filter Fabric: Nonwoven geotextile manufactured for separation applications and made of polypropylene, polyolefin, or polyester fibers or combination of them.
F. Mycorrhizal Fungi: Dry, granular inoculant containing at least 5300 spores per lb of vesicular-arbuscular mycorrhizal fungi and 95 million spores per lb of ectomycorrhizal fungi, 33 percent hydrogel, and a maximum of 5.5 percent inert material.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.
   1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
   2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
   3. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
   4. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by ENGINEER and replace with new planting soil.

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

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain ENGINEER's acceptance of layout before excavating or planting. Make minor adjustments as required.

D. Lay out plants at locations directed by ENGINEER. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

3.3 PLANTING AREA ESTABLISHMENT

A. General: Prepare planting area for soil placement and mix planting soil according to Section 329115 "Soil Preparation (Performance Specification)."
B. Placing Planting Soil: Place and mix planting soil in-place over exposed subgrade.

C. Before planting, obtain ENGINEER's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

D. Application of Mycorrhizal Fungi: At time directed by ENGINEER, broadcast dry product uniformly over prepared soil at application rate according to manufacturer's written recommendations.

3.4 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits.
   1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
   2. Excavate approximately three times as wide as ball diameter for balled and burlapped stock.
   3. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
   4. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
   5. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
   6. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
   7. Maintain supervision of excavations during working hours.
   8. Keep excavations covered or otherwise protected when unattended by Installer's personnel.
   9. If drain tile is indicated on Drawings or required under planting areas, excavate to top of porous backfill over tile.

B. Backfill Soil: Subsoil and topsoil removed from excavations may be used as backfill soil unless otherwise indicated.

C. Obstructions: Notify ENGINEER if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
   1. Hardpan Layer: Drill 6-inch diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.

D. Drainage: Notify ENGINEER if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.
3.5 TREE, AND SHRUB PLANTING

A. Inspection: At time of planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.

B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

C. Balled and Burlapped Stock: Set each plant plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades.
   1. Backfill: Planting soil. For trees, use excavated soil for backfill.
   2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
   3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
   4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
      a. Quantity: Two per plant.
   5. Continue backfilling process. Water again after placing and tamping final layer of soil.

D. Balled and Potted and Container-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades.
   1. Backfill: Planting soil. For trees, use excavated soil for backfill.
   2. Carefully remove root ball from container without damaging root ball or plant.
   3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
   4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
      a. Quantity: Two per plant.
   5. Continue backfilling process. Water again after placing and tamping final layer of soil.

3.6 TREE STABILIZATION

A. Trunk Stabilization by Upright Staking and Tying: Install trunk stabilization as follows unless otherwise indicated:
   1. Upright Staking and Tying: Stake trees of 2- through 5-inch caliper. Stake trees of less than 2-inch caliper only as required to prevent wind tip out. Use a
minimum of two stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation and to extend one-third of trunk height above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.

3.7 GROUND COVER AND PLANT PLANTING

A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on Drawings in even rows with triangular spacing.

B. Use planting soil for backfill.

C. Dig holes large enough to allow spreading of roots.

D. For rooted cutting plants supplied in flats, plant each in a manner that minimally disturbs the root system but to a depth not less than two nodes.

E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.8 PLANTING AREA MULCHING

A. Install weed-control barriers before mulching according to manufacturer's written instructions. Completely cover area to be mulched, overlapping edges a minimum of 6 inches and secure seams with galvanized pins.

B. Mulch backfilled surfaces of planting areas and other areas indicated.
   1. Trees and Treelike Shrubs in Turf Areas: Apply organic mulch ring of 3-inch average thickness, with 36-inch radius around trunks or stems. Do not place mulch within 3 inches of trunks or stems.
   2. Organic Mulch in Planting Areas: Apply 3-inch average thickness of organic mulch extending 12 inches beyond edge of individual planting pit or trench and over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.

3.9 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.

B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.10 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Pre-Emergent Herbicides (Selective and Nonselective): Apply to tree, shrub, and ground-cover areas according to manufacturer's written recommendations. Do not apply to seeded areas.

C. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.11 REPAIR AND REPLACEMENT

A. General: Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by ENGINEER.

1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by ENGINEER.

B. Remove and replace trees that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that ENGINEER determines are incapable of restoring to normal growth pattern.

3.12 CLEANING AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
D. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

E. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.

END OF SECTION 329300
SECTION 334800 - STORMWATER MANAGEMENT FACILITY

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 WORK INCLUDED

A. The work covered by this section includes the construction of the Micro-bioretention Facilities, including, but not limited to, overflow inlets and outlet pipes, special earthwork requirements, underdrains, filter fabric and maintenance.

B. The Micro-bioretention Facilities shall be constructed as indicated on the plans.

C. Work installed to be furnished under other sections, except as may be modified in this section, are:

1. Section 312000, Earth Moving
2. Section 329200, Turf and Grasses
3. Section 329300, Plants

1.3 REFERENCE SPECIFICATION

A. The work under this Section shall be in accordance with applicable portions of the "Standard Specifications for Construction Materials" of the Maryland Department of Transportation, State Highway Administration, dated July 2018, including any addenda thereto.

B. Measurement and Payment clauses contained in the Reference Specifications will not apply to this Contract.

C. All reference to the term "Engineer" shall mean ENGINEER.

1.4 QUALITY CONTROL

A. Inspection Agency: An independent Inspection Agency for complete inspection and testing of soils and compaction and certifying and preparation of "Design / As-Built Data" tables, “As-Built Certification”, and drawings of the completed Stormwater Management Micro-bioretention Facilities shall be provided by the Contractor. The certification of a Professional Engineer licensed in the State of Maryland will be required of the Inspection Agency. The Contractor is responsible for submitting required As-Built information to Maryland Department of the Environment Water and Science Administration (MDE WSA).

B. The Inspection Agency will be required to furnish the and “As-Built Certification”, as indicated on the plans and required by the MDE WSA for certification of SWM ESD facilities 30 days after completion of the pond construction.
Bowie State University – Car Parking Lot

C. The Contractor shall be required to provide the Micro-bioretention Facilities as specified and indicated on the drawings. Any deviations from the specifications and/or plans shall be corrected at no cost to the Owner.

PART 2 - PRODUCTS

A. All products shall be in accordance with the reference specifications and as indicated on the plans.

PART 3 - EXECUTION

3.1 CONSTRUCTION METHODS

A. The construction of all facilities shall be in accordance with the reference specifications and as indicated on the plans. The Contractor shall follow the “Contractor Sequence of Construction” for all construction.

B. Vegetative Treatment: Stabilize embankment in accordance with the appropriate vegetative Standard and Specifications immediately following construction. The Contractor shall stabilized contributing drainage areas to Micro-bioretention Facilities as indicated on the plans.

C. Erosion and Pollution Control: Construction operations shall be carried out in such a manner that erosion and water pollution will be minimized. Comply with state and local laws concerning pollution abatement.

D. Safety: State and local requirements shall be met concerning fencing and signs, warning the public of the hazards of soft sediment and floodwater.

E. Maintenance:

1. Repair all damages caused by soil erosion or construction equipment before end of each working day.

2. Stabilize all embankments, slopes, spillways, etc. immediately after construction of facilities, even if only temporary.

END OF SECTION 334800
SECTION 334200 - STORMWATER CONVEYANCE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipe and fittings.
2. Nonpressure transition couplings.
3. Cleanouts.
5. Catch basins.
7. Pipe outlets.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Manholes: Include plans, elevations, sections, details, frames, and covers.
2. Catch basins, stormwater inlets. Include plans, elevations, sections, details, frames, covers, and grates.
3. Stormwater Detention Structures: Include plans, elevations, sections, details, frames, covers, design calculations, and concrete design-mix reports.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.

B. Product Certificates: For each type of cast-iron soil pipe and fitting, from manufacturer.

C. Field quality-control reports.
1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
B. Protect pipe, pipe fittings, and seals from dirt and damage.
C. Handle manholes according to manufacturer's written rigging instructions.
D. Handle catch basins and stormwater inlets according to manufacturer's written rigging instructions.

PART 2 - PRODUCTS

2.1 PE PIPE AND FITTINGS

A. Corrugated PE Drainage Pipe and Fittings NPS 3 to NPS 10 (DN 80 to DN 250):
   AASHTO M 252M, Type S, with smooth waterway for coupling joints.
B. Corrugated PE Pipe and Fittings NPS 12 to NPS 60 (DN 300 to DN 1500): AASHTO M 294M,
   Type S, with smooth waterway for coupling joints.

2.2 PVC PIPE AND FITTINGS

A. PVC Water-Service Piping:
   1. Pipe: ASTM D 1785, Schedule 40 PVC, with plain ends for solvent-cemented joints.
   2. Fittings: ASTM D 2466, Schedule 40 PVC, socket type.
B. Solvent Cement: ASTM D 2564.
   1. Solvent cement shall have a VOC content of 510 g/L or less.

2.3 NONPRESSURE TRANSITION COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for
   joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and
   corrosion-resistant-metal tension band and tightening mechanism on each end.
B. Sleeve Materials:
   1. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
   2. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe
      materials being joined.
2.4 CLEANOUTS

A. PVC Cleanouts:
   1. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser
to cleanout of same material as sewer piping.

2.5 MANHOLES

A. Standard Precast Concrete Manholes:
   1. Description: ASTM C 478 (ASTM C 478M), precast, reinforced concrete, of depth
indicated, with provision for sealant joints.
   2. Diameter: 48 inches (1200 mm) minimum unless otherwise indicated.
   3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as
required to prevent flotation.
   4. Base Section: 6-inch (150-mm) minimum thickness for floor slab and 4-inch (102-mm)
minimum thickness for walls and base riser section, and separate base slab or base
section with integral floor.
   5. Riser Sections: 4-inch (102-mm) minimum thickness, and lengths to provide depth
indicated.
   6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is
indicated, and top of cone of size that matches grade rings.
   8. Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into manhole
walls, for each pipe connection.
   9. Steps: Individual FRP steps; FRP ladder; or ASTM A 615/A 615M, deformed, 1/2-inch
(13-mm) steel reinforcing rods encased in ASTM D 4101, PP wide enough to allow
worker to place both feet on one step and designed to prevent lateral slippage off step.
Cast or anchor steps into sidewalls at 12- to 16-inch (300- to 400-mm) intervals. Omit
steps if total depth from floor of manhole to finished grade is less than 60 inches (1500
mm).
   10. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, to
match diameter of manhole frame and cover, and height as required to adjust manhole
frame and cover to indicated elevation and slope.

B. Designed Precast Concrete Manholes:
   1. Description: ASTM C 913; designed according to ASTM C 890 for A-16
(AASHTO HS20-44), heavy-traffic, structural loading; of depth, shape, and dimensions
indicated, with provision for sealant joints.
   2. Ballast: Increase thickness of one or more precast concrete sections or add concrete to
manhole as required to prevent flotation.
   4. Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into manhole
walls, for each pipe connection.
   5. Steps: Individual FRP steps; FRP ladder; or ASTM A 615/A 615M, deformed, 1/2-inch
(13-mm) steel reinforcing rods encased in ASTM D 4101, PP wide enough to allow
worker to place both feet on one step and designed to prevent lateral slippage off step.
Cast or anchor steps into sidewalls at 12- to 16-inch (300- to 400-mm) intervals. Omit
C. Manhole Frames and Covers:

1. Description: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch- (102-mm-) minimum width flange and 26-inch- (660-mm-) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."

2.6 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R (ACI 350M/350RM), and the following:

1. Cement: ASTM C 150, Type II.

B. Portland Cement Design Mix: 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio.

2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
   a. Invert Slope: 1 percent through manhole.

2. Benches: Concrete, sloped to drain into channel.
   a. Slope: 4 percent.

D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi (20.7 MPa) minimum, with 0.58 maximum water/cementitious materials ratio.

2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.
2.7 CATCH BASINS

A. Standard Precast Concrete Catch Basins:

1. Description: ASTM C 478 (ASTM C 478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Base Section: 6-inch (150-mm) minimum thickness for floor slab and 4-inch (102-mm) minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
3. Riser Sections: 4-inch (102-mm) minimum thickness, 48-inch (1200-mm) diameter, and lengths to provide depth indicated.
4. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
6. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch (150- to 225-mm) total thickness, that match 24-inch- (610-mm-) diameter frame and grate.
7. Steps: Individual FRP steps; FRP ladder; or ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch (300- to 400-mm) intervals. Omit steps if total depth from floor of catch basin to finished grade is less than [60 inches (1500 mm)].
8. Pipe Connectors: ASTM C 923 (ASTM C 923M), resilient, of size required, for each pipe connecting to base section.

B. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include flat grate with small square or short-slotted drainage openings.

1. Size: 24 by 24 inches (610 by 610 mm) minimum unless otherwise indicated.
2. Grate Free Area: Approximately 50 percent unless otherwise indicated.

2.8 STORMWATER INLETS

A. Curb Inlets: Made with vertical curb opening, of materials and dimensions according to utility standards.

B. Gutter Inlets: Made with horizontal gutter opening, of materials and dimensions according to utility standards. Include heavy-duty frames and grates.

C. Combination Inlets: Made with vertical curb and horizontal gutter openings. Include heavy-duty frames and grates.

D. Frames and Grates: Heavy duty.

2.9 PIPE OUTLETS

A. Head Walls: Cast-in-place reinforced concrete, with apron and tapered sides.
B. Riprap Basins: Broken, irregularly sized and shaped, graded stone according to NSSGA's "Quarried Stone for Erosion and Sediment Control."

PART 3 - EXECUTION

3.1 EARTHWORK
A. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION
A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
F. Install gravity-flow, nonpressure drainage piping according to the following:
   1. Install piping pitched down in direction of flow.
   2. Install PE corrugated sewer piping according to ASTM D 2321.
   3. Install PVC water-service piping according to ASTM D 2321 and ASTM F 1668.

3.3 PIPE JOINT CONSTRUCTION
A. Join gravity-flow, nonpressure drainage piping according to the following:
   1. Join corrugated PE piping according to ASTM D 3212 for push-on joints.
   2. Join PVC cellular-core piping according to ASTM D 2321 and ASTM F 891 for solvent-cemented joints.
   3. Join PVC corrugated sewer piping according to ASTM D 2321 for elastomeric-seal joints.
   4. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasketed joints.
5. Join PVC profile gravity sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.

3.4 CLEANOUT INSTALLATION
   A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
   B. Set cleanout frames and covers in earth in as indicated on the drawings.
   C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.5 MANHOLE INSTALLATION
   A. General: Install manholes, complete with appurtenances and accessories indicated.
   B. Install precast concrete manhole sections with sealants according to ASTM C 891.
   C. Where specific manhole construction is not indicated, follow manhole manufacturer's written instructions.
   D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches (76 mm) above finished surface elsewhere unless otherwise indicated.

3.6 CATCH BASIN INSTALLATION
   A. Construct catch basins to sizes and shapes indicated.
   B. Set frames and grates to elevations indicated.

3.7 STORMWATER INLET AND OUTLET INSTALLATION
   A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.
   B. Construct riprap of broken stone, as indicated.
   C. Install outlets that spill onto grade, anchored with concrete, where indicated.
   D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.
   E. Construct energy dissipaters at outlets, as indicated.

3.8 CONCRETE PLACEMENT
   A. Place cast-in-place concrete according to ACI 318.
3.9 CONNECTIONS

A. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch (150-mm) overlap, with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).

2. Make branch connections from side into existing piping, NPS 4 to NPS 20 (DN 100 to DN 500). Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).

3. Make branch connections from side into existing piping, NPS 21 (DN 525) or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches (76 mm) of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 6 inches (150 mm) of concrete for minimum length of 12 inches (300 mm) to provide additional support of collar from connection to undisturbed ground.

   a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi (20.7 MPa) unless otherwise indicated.
   b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.10 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

   1. Close open ends of piping with at least 8-inch- (203-mm-) thick, brick masonry bulkheads.
   2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:

   1. Remove manhole or structure and close open ends of remaining piping.
   2. Remove top of manhole or structure down to at least 36 inches (915 mm) below final grade. Fill to within 12 inches (300 mm) of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.

C. Backfill to grade according to Section 312000 "Earth Moving."
3.11 IDENTIFICATION

A. Materials and their installation are specified in Section 312000 "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.

1. Use warning tape or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.12 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (610 mm) of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:
   a. Alignment: Less than full diameter of inside of pipe is visible between structures.
   b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
   c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
   d. Infiltration: Water leakage into piping.
   e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
   a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
   b. Option: Test plastic piping according to ASTM F 1417.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.
3.13 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with water.

END OF SECTION 334200