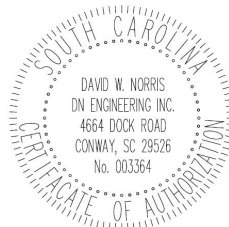


Horry County School
HCS Transportation
Training Pad
Conway, South Carolina



Prepared by:
DN Engineering, Inc.
4664 Dock Road
Conway, South Carolina



07/21/2021



July 21, 2021

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Civil Site Specifications
HCS Transportation Training Pad
Conway, South Carolina



REPORT OF SUBSURFACE EXPLORATION
AND PRELIMINARY GEOTECHNICAL EVALUATION
HORRY COUNTY SCHOOLS RECORDS CENTER SITE
2205 CHURCH STREET
CONWAY, SOUTH CAROLINA 29526
BUILDING & EARTH PROJECT NO.: **RD200105**

PREPARED FOR:
ECLS Global, Inc.

MARCH 20, 2020



Geotechnical, Environmental, and Materials Engineers

March 20, 2020

Horry County Schools
c/o ECLS Global, Inc.
1160 E. Hwy 501
Conway, SC 29526

Attention: Mr. Dennis McCray

Subject: Report of Subsurface Exploration and Preliminary Geotechnical Evaluation
Horry County Schools Records Center Site
Conway, South Carolina
Building & Earth Project No: RD200105

Dear Mr. McCray:

Building & Earth Sciences, LLP. has completed the authorized subsurface exploration and preliminary pavement design recommendations for the Horry County Schools records center bus fueling station and training pad located on 2205 Church street in Conway, South Carolina.

The purpose of this exploration and evaluation has been to evaluate general subsurface conditions at the site and to prepare pavement section recommendations for the project. Recommendations in this report are based on a physical reconnaissance of the site and observation and classification of samples obtained from ten (10) soil test borings drilled at the site.

The analysis and recommendations presented in this report shall be considered preliminary and should not be used for final design or construction. Site plans, traffic loads, and grading information was not available at the time of this reporting. Further evaluation, once these details are available, and confirmation of the anticipated subsurface conditions during construction, are an essential part of geotechnical services.

We appreciate the opportunity to provide our services for this project. If there are any questions regarding the information in this report or if additional information is required, please call.

Respectfully Submitted,
BUILDING & EARTH SCIENCES, LLP.



Monique Lumpkin
Field Professional



Kurt A. Miller, PE
Regional Manager



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APPENDIX

1.0 PROJECT & SITE DESCRIPTION

Proposed for construction is a new fueling station and bus training pad on the Horry County Schools (HCS) Records Center site. The site is located at 2205 Church Street in the southwest quadrant of the Church Street - Richardson Street intersection, in Conway, South Carolina. The site is currently occupied by the HCS Records Center, a maintenance shop and a building slab.

We understand this preliminary investigation is being performed as part of preliminary design services in support of sitework and paving improvements. Geotechnical recommendations presented in this report will therefore be considered preliminary until traffic information has been provided and Building & Earth has had the opportunity to review civil plans signed and sealed by a professional engineer registered in the State of South Carolina.

Depending on final grading plans, supplemental subsurface exploration and geotechnical analyses may be warranted to prepare final geotechnical recommendations. Photographs depicting the current site conditions appear below.



Figure 1: Approximate Geotechnical Scope Boundary



Figure 2: Looking Northeast from Southwest Corner



Figure 3: Looking Southwest from Northeast Corner



Figure 4: Looking Northwest from Southeast Corner

2.0 SCOPE OF SERVICES

The authorized subsurface exploration was performed on February 21 and 27, 2020 in conformance with Survey & Geotechnical proposal for Horry County Schools Records Center sitework improvements, dated December 13, 2019. Occasionally some modification to work scopes appearing in our proposals is required to provide for proper evaluation of encountered subsurface conditions. No modification to the scope was necessary for this study.

The purpose of the geotechnical exploration has been to characterize general subsurface conditions at specific boring locations and to gather data on which to base a geotechnical evaluation with respect to the proposed construction. The subsurface exploration for this project consisted of ten (10) hand auger test borings. At each location, Kessler DCP testing was performed in general accordance with ASTM D6951 by vertically dropping a 17.6-pound weight a distance of 22.6 inches, and recording the number of millimeters of penetration per hammer blow. A 4-inch diameter bucket-style auger with an extendable handle was used to bore and collect soil samples. Upon completion, standard penetration test values were estimated using the Kessler DCP data. Estimated N-values are reported on the boring logs.

Soil boring sites were field located by a representative of our staff using Garmin 63ST GPS and site plans provided by the client. As such, boring positions appearing on the Boring Location Plan attached to this report should be considered approximate.

Soil samples recovered during our site investigation were visually classified and specific samples were selected by the project engineer for laboratory analysis. The laboratory analyses consisted of:

Test	ASTM	No. of Tests
Natural Moisture Content	D2216	12
Atterberg Limits	D4318	3
Material Finer Than No. 200 Sieve by Washing	D1140	3
Kessler Dynamic Cone Penetrometer (in Situ CBR)	D6951	10

Table 1: Scope of Laboratory Tests

Results of the laboratory analyses are presented on the attached Boring Logs and in tabular form in the report Appendix. Descriptions of laboratory tests that were performed are also included in the Appendix.

Information gathered from the exploration was evaluated to develop heavy-duty pavement sections for the bus fueling station and training pad. The information was also evaluated to identify any special subgrade preparation procedures that may be required during the project earthworks phase.

Results of the work presented in this report address:

- Summary of existing surface conditions.
- A description of the subsurface conditions encountered at the boring locations.
- Site preparation considerations including material types to be expected during grading as well as recommendations regarding handling and treatment of unsuitable soils, if encountered.
- Compaction requirements and recommended criteria to establish suitable surfaces for structural backfill.
- Boring logs describing materials encountered with soil classifications, penetration values, and groundwater levels (if measured).
- Presentation of laboratory test results.
- Preliminary recommendations for pavement design

- Plans and maps showing the location of the project and our onsite work.

3.0 GEOTECHNICAL SITE CHARACTERIZATION

The following paragraphs are intended to provide a general characterization of the site from a geotechnical engineering perspective. It is not the intention of this report to address every potential geotechnical matter that may arise, nor to provide every possible interpretation of conditions identified. The following condition descriptions and subsequent recommendations are based, in part, on the assumption significant changes in subsurface conditions do not occur between boreholes. However, anomalous conditions can occur due to variations in existing fill that may be present at the site, or due to natural geologic variations. It will be necessary to compare assumed to actual conditions during site grading and pavement construction.

3.1 EXISTING SURFACE CONDITIONS

At the time of our field work, the site was described as well drained with about 8 feet of surface relief estimated from ground surface elevations at the boring sites. Per Google Earth aerial imagery, on-site elevations range from approximately 26 feet to 34 feet. A records center, maintenance shop and building slab currently occupy the site, several buildings have been removed from the site, and up to about 2 feet of fill has been placed at various locations on the site. Records suggest fill materials has not been placed with engineering controls. Neither locations, depths nor suitability with respect to pavement support of any in-situ fill material has been addressed as part of this study.

Vegetation on the site consist of grass and mature trees along the south and west boundary. Historical aerial imagery indicates the site has had the same configuration since at least 1994, with relatively recent demolition of several buildings.

3.2 SUBSURFACE CONDITIONS

A generalized stratification summary has been prepared using data from the soil test borings and is tabulated below. The stratification depicts general soil conditions and strata types encountered during our field investigation.

Stratum No.	Typical Thickness	Description	Consistency
1	3 – 5 in.	Topsoil	N/A
2	3 – 5 in	Crushed Stone	N/A
3	1.5 – 3 ft.	Fill – Clayey Sand (SC), Silty Sand (SM)	Very Loose to Medium Dense
4	2.0 – 4.0+ ft.	Fat Clay (CH)	Stiff to Very Stiff
5	1.0 ft.	Silty Sand (SM)	Medium Dense

Table 2: Stratification Summary

Subsurface soil profiles have also been prepared based on the data obtained at specific boring locations. The subsurface soil profiles are presented in the Appendix. For specific details on the information obtained from individual soil borings, please refer to the Boring Logs included in the Appendix. Ground surface elevations at the boring sites were estimated using the Google Earth imagery. As such, these elevations should be considered approximate.

3.2.1 TOPSOIL

Topsoil was encountered in borings B-01, B-03 and B-04 with a thickness of approximately 3 to 5 inches. No testing has been performed to verify this material meets the requirements of “topsoil”. Topsoil depths reported should only be considered an estimate as topsoil thickness may vary in unexplored portions of the site.

3.2.2 CRUSHED STONE

Crushed stone, generally described as NCDOT No. 57, was encountered in boring B-09 and B-10 with a thickness of approximately 3 to 5 inches. No testing has been performed to verify this material meets the requirements of NCDOT No. 57 stone. The stone depths reported should only be considered an estimate as thicknesses may vary in unexplored portions of the site.

3.2.3 FILL - CLAYEY SAND (SC) AND SILTY SAND (SM)

Soils described as clayey sand (SC) or silty sand (SM) were observed in all borings, except B-01, B-03, and B-04, extending to depths up to 3 feet below the surface. SPT N-values in this soil layer range from 0 to 22 blows per foot. Soils in this layer are further described as very loose to medium dense, brown to reddish-brown, fine to medium grained, and moist. No laboratory testing was performed to verify this material meets the requirements of “Clayey Sand or Silty Sand”. Auger refusal was encountered in boring B-10 at 2 feet below the surface within this stratum, due to possible buried debris from previous site buildings.

3.2.4 FAT CLAY (CH)

Soils described as fat clay (CH) were observed in all borings below the clayey sand (SC) layer described above. SPT N-values in this layer range from 8 to 20 blows per foot. Soils in this layer are further described as stiff to very stiff, brown to reddish brown, fine grained, and moist to wet.

Laboratory test performed on this material indicate a fines (passing standard #200 sieve) content of 54 to 65.8 percent, liquid limit values of 50 to 61, and plasticity indices of 30 to 38. These values correspond to USCS CH classification.

3.2.5 SILTY SAND

Naturally occurring soils described as silty sand (SM) were encountered in boring B-04, below the fat clay (CH) layer described above, extending to depths 5.0 feet below the surface. These soils are generally described as medium dense, light brown, fine to medium grained, and wet. SPT N-values in the stratum were at approximately 10 blows per foot.

3.2.6 AUGER REFUSAL

Auger refusal is the drilling depth at which a borehole can no longer be advanced using soil drilling procedures. Auger refusal can occur on hard soil, boulders, buried debris or bedrock. Coring is required to sample the material below auger refusal. Auger refusal was encountered in boring B-10, about 2 feet below the surface.

3.2.7 GROUNDWATER

At the time of drilling, groundwater, perched or otherwise, was encountered in several borings. Water levels reported are accurate only for the time and date that the borings were drilled. Long term monitoring of the boreholes was not included as part of our subsurface exploration. The borings were backfilled the same day that they were drilled. Groundwater data is included in the following table.

Boring No.	Depth (ft)	Elevation (ft)	Boring No.	Depth (ft)	Elevation (ft)
B-01	--	--	B-06	3.1	27.9
B-02	1.0	32.0	B-07	--	--
B-03	2.5	22.5	B-08	--	--
B-04	5.0	21.0	B-09	--	--
B-05	--	--	B-10	1.0	25.0

Table 3: Groundwater Depths and Estimated Elevations

4.0 SITE DEVELOPMENT CONSIDERATIONS

The area explored is suited to construction of the proposed Horry County School Records Center site bus fueling station and training pad. Geotechnical considerations affecting the project include:

- Stripping of topsoil and clearing of organic materials from construction areas,
- Subgrade preparation including compaction of surface materials in order to prepare a firm and competent subgrade condition.
- Previously placed fill soils encountered in borings.
- Presence of potential buried debris in building areas and auger refusal at boring B-10.
- Grading to provide efficient drainage of pavement surfaces and unpaved ground adjacent to paved surfaces.

Recommendations addressing the site conditions are presented in the following sections.

4.1 INITIAL SITE PREPARATION

Initial site preparation should include the clearing of all topsoil gravel surface and otherwise deleterious materials from proposed bus fueling station and training pad locations. Approximately 3 to 5 inches of topsoil were observed in borings B-01, B-03, and B-04, and 3 to 5 inches of crushed stone were observed at the surface at borings B-09 and B-10. The geotechnical engineer should observe stripping and grubbing operations to confirm all unsuitable materials are removed from locations for proposed construction.

Because of past use, buried structures such as foundations, utility lines, septic tanks, etc. may be present in the subsurface. If encountered, these should be removed and the resulting excavations backfilled in accordance with requirements appearing in the Structural Fill section of this report. Up to about 3 feet of fill was observed in borings B-02, B-05, B-06, B-07, B-08 and B-09, and auger refusal occurred at about 2 feet in boring B-10. We recommend in-situ fill soils be evaluated via test pits to confirm it is free of excess organic matter other deleterious materials. Provided it is acceptable for use as pavement or training pad support material, it is recommended this material be densified or compacted prior to roadway or slab construction. Evaluation of the material should be performed, and recommendations for densification/compaction, should be provided by the geotechnical engineer following the evaluation.

Materials disturbed during clearing operations should be stabilized in place or, if necessary, undercut to undisturbed materials and backfilled with properly compacted, approved structural fill.

During site preparation, the contractor should identify borrow source materials that will be used as structural fill and provide samples to the testing laboratory so that conformance to Structural Fill recommendations presented below can be confirmed, in order that laboratory moisture-density (Proctor) testing can be completed prior to commencement of fill operations.

4.2 SUBGRADE EVALUATION

We recommend that the project geotechnical engineer or a qualified representative evaluate the subgrade after the site is prepared. Some unsuitable or unstable areas may be present in unexplored areas of the site. All areas that will require fill or that will support structures should be carefully proofrolled with a heavy (40,000 # minimum), rubber-tired vehicle at the following times.

- After an area has been stripped, and undercut if required, prior to the placement of any fill.
- After grading an area to the finished subgrade elevation in a building or pavement area.
- After areas have been exposed to any precipitation, and/or have been exposed for more than 48 hours.

Some instability may exist during construction, depending on climatic and other factors immediately preceding and during construction. If any soft or otherwise unsuitable soils are identified during the proofrolling process, they must be undercut or stabilized prior to fill placement, pavement construction, or floor slab construction. All unsuitable material identified during the construction shall be removed and replaced in accordance with the Structural Fill section of this report.

4.3 MOISTURE SENSITIVE SOILS

Moisture sensitive silty sands (SM) and clayey sands (SC) were encountered across most of the site during the subsurface exploration. These soils will degrade if allowed to become saturated. Therefore, not allowing water to pond by maintaining positive drainage and temporary dewatering methods (if required) is important to help avoid degradation and softening of the soils.

The contractor should anticipate some difficulty during the earthwork phase of this project if moisture levels are moderate to high during construction. Increased moisture levels will soften the subgrade and the soils may become unstable under the influence of construction traffic. Accordingly, construction during wet weather conditions should be avoided, as this could result in soft and unstable soil conditions that would require ground modification, such as in place stabilization or undercutting.

4.4 LOW RELATIVE DENSITY SOILS

Where low relative-density soils (N-values less than 10 using a manual hammer) are encountered, densification is recommended prior to proofrolling. Densification can be achieved using a heavy (10 ton minimum) smooth drum vibratory roller. If densification is performed, a rolling pattern that demonstrates densification through the low relative density strata should be developed, and densification observations should be observed by the geotechnical engineer.

If the soils cannot be stabilized in place, it may be necessary to remove the soils to a stable, suitable subgrade and replaced with compacted structural fill. The undercutting or in-situ stabilization should extend laterally 5 feet outside the pavement or structural footprint. All stabilization work should be observed by the geotechnical engineer or a qualified representative or the geotechnical engineer.

Some unsuitable or unstable areas may be present in unexplored areas of the site. Once the known undercut is complete, the areas planned for construction should be proofrolled in order to identify any additional soft soils requiring removal.

Undercut soils should be replaced with structural fill. Clean, non-organic, non-saturated soils taken from the undercut area can be re-used as structural fill. The placement procedure, compaction and composition of the structural fill must meet the requirements of the Structural Fill section of this report.

4.5 EVALUATION OF HIGH PLASTICITY CLAY

Soils described as CH (highly plastic clay) were observed in all but boring B-10 beginning at depths 1 to 3 feet below the surface. The fines content of this material is generally in the range 55 to 60 percent suggesting a relatively low shrink-swell potential. However, it should be recognized that this material may pose some risk with respect to volume change with fluctuating moisture content, and will have the potential for deterioration under dynamic (pavement subgrade) loading.

We recommend preliminary planning address the use and presence of this material. Further evaluation (classification testing with hydrometer grain size analysis) is recommended as part of a final geotechnical study. Preliminary recommendations with respect to this material are:

- Where it occurs beneath pavements and training pads, the material should be buried at least 18-inches below the subgrade surface.
- This material is not (on a preliminary basis) recommended for use in construction of fill embankments that will support buildings, training slabs or pavements unless it is placed a minimum 18-inches below embankment surfaces.
- It is generally recommended that the geotechnical engineer of record, or a qualified representative, observe placement and any undercutting operations of these materials.

4.6 STRUCTURAL FILL

Requirements for structural fill on this project follow:

Soil Type	USCS Classification	Property Requirements	Placement Location
Sand and Gravel	GW, GP, GM, SW, SP, SM or combinations	Maximum 2" particle size	Areas where the material can be confined, and adequate drainage provided
Clay	CL, SC, GC	LL < 50, PI < 25, γ_d > 100 pcf	Fill and Backfill
Clay/Silt	CH/MH	LL > 50, PI > 25, γ_d > 100 pcf	Not Recommended for Use
On-site soils	Onsite Soils	Maximum 2" particle size	SC, SM: Areas where the material can be confined, and adequate drainage provided. CH: Not recommended for use.

Table 4: Structural Fill Requirements

Notes:

1. LL indicates the soil Liquid Limit; PI indicates the soil Plasticity Index; γ_d indicates the maximum dry density as defined by the density standard outlined in the table below.
2. Laboratory testing of the soils proposed for fill must be performed in order to verify their conformance with the above recommendations.
3. Any fill to be placed at the site should be reviewed by the geotechnical engineer.

Placement requirements for structural fill are as follows:

Specification	Requirement
Lift Thickness	8" loose, 6" compacted
Density	98 Percent minimum per ASTM D-698
Moisture	±3% of the optimum moisture content as determined by ASTM D698
Density Testing Frequency	1 test per 2,500 S.F., minimum 2 tests per lift

Table 5: Structural Fill Placement Requirements

4.7 EXCAVATION CONSIDERATIONS

All excavations performed at the site should follow OSHA guidelines for temporary excavations. Excavated soils should be stockpiled according to OSHA regulations to limit the potential cave-in of soils.

4.7.1 GROUNDWATER

Groundwater perched otherwise was encountered at depths of approximately 1 to 5 feet in five of the ten borings. Groundwater could be encountered during construction, particularly during undercutting operations. It should be noted that fluctuations in the water level could occur due to seasonal variations in rainfall. The contractor must be prepared to remove groundwater seepage from excavations if encountered during construction. Excavations extending below groundwater levels will require dewatering systems (such as well points, sump pumps or trench drains). The contractor should evaluate the most economical and practical dewatering method.

4.8 UTILITY TRENCH BACKFILL

All utility trenches must be backfilled and compacted in the manner specified above for structural fill. It may be necessary to reduce the lift thickness to 4 to 6 inches to achieve compaction using hand-operated equipment.

4.9 LANDSCAPING AND DRAINAGE CONSIDERATION

The potential for soil moisture fluctuations within building areas and pavement subgrades should be reduced to lessen the potential of subgrade movement. Site grading should include positive drainage away from buildings and pavements. Excessive irrigation of landscaping poses a risk of saturating and softening soils below shallow footings and pavements, which could result in settlement of footings and premature failure of pavements.

4.10 WET WEATHER CONSTRUCTION

Excessive movement of construction equipment across the site during wet weather may result in ruts, which will collect rainwater, prolonging the time required to dry the subgrade soils.

During rainy periods, additional effort will be required to properly prepare the site and establish/maintain an acceptable subgrade. The difficulty will increase in areas where clay or silty soils are exposed at the subgrade elevation. Grading contractors typically postpone grading operations during wet weather to wait for conditions that are more favorable. Contractors can typically disk or aerate the upper soils to promote drying during intermittent periods of favorable weather. When deadlines restrict postponement of grading operations, additional measures such as undercutting and replacing saturated soils or stabilization can be utilized to facilitate placement of additional fill material.

5.0 PAVEMENT CONSIDERATIONS

For preliminary planning purposes, the following pavement section estimates have been prepared. Based on the materials encountered at the boring locations and after our recommendations for site preparation are implemented, pavements at the subject site may be designed based on a California Bearing Ratio (CBR) of eight (8). This CBR estimate is based upon average CBR values in the upper 18-inches of the soil profile, adjusted for some deterioration due to potentially wet subgrade conditions.

Subgrade and traffic analyses are required to provide comprehensive pavement section recommendations. Specific traffic information was not provided. Once the site grading has been designed, and traffic loading can be provided, we would be pleased to provide a design for the proposed bus fueling station and training pad. Results of our preliminary analysis follow:

Type	Automobiles (per day)	Delivery Trucks (2-Axle/4-Tire) (per day)	Buses (per day)	Garbage Trucks (per week)	Delivery Trucks (2-Axle/6-Tire) (per day)	ESAL
Standard Duty	500	1	50	1	1	2.7E+05
Heavy Duty	500	2	100	1	2	5.2E+05

Table 9: Assumed Traffic Volume

The volumes shown above are just one example of possible vehicle types and daily traffic that would result in the total equivalent 18-kip single-axle load (ESAL) shown. It has been our experience that parking lots experience a certain level of wear and stress greater than

roadways designed for similar traffic volumes. Therefore, parking lots are typically designed using the AASHTO method and adjusted based on experience. If the owner would like Building & Earth to assess other likely traffic volumes, we will gladly review other options. In addition, we have assumed the following design parameters:

Design Criteria	Value
Design life (Years)	20
Terminal Serviceability	2.0
Reliability	85%
Initial Serviceability	4.2
Standard Deviation	0.45 (Flexible)
Standard Deviation	0.35 (Rigid)

Table 10: Assumed Design Parameters

5.1 FLEXIBLE PAVEMENT

The asphalt pavement sections described herein were designed using the “AASHTO Guide for Design of Pavement Structures, 1993”. Alternative pavement sections were designed by establishing the structural numbers used for the AASHTO design system and substituting materials based upon structural equivalency as follows:

Material	Structural No.
Asphalt Concrete	0.44
Crushed Stone Base	0.14

Table 12: Structural Equivalent Coefficient

The following flexible pavement sections are based on the design parameters presented above:

Preliminary Flexible Pavement Section ¹ (in.)		
Minimum Recommended Thickness (in.)		Material
Standard Duty	Heavy Duty	
2.0	2.0	Surface Course
4.0	3.0	Binder Course
8.0	8.0	Crushed Stone Base

Table 13: Asphalt Pavement Recommendations

Notes: 1. All Paving operations should comply with minimum standards required by SCDOT

5.2 RIGID PAVEMENT

The following rigid pavement sections are based on the design parameters presented above. We assume an effective modulus of subgrade reaction (k) of 130 pci, a concrete elastic modulus (E_c) of 3.6×10^6 psi, and a concrete modulus of rupture (S'_c) of 650 psi.

Preliminary Rigid Pavement Section ¹ (in.)		
Minimum Recommended Thickness (in.)		Material
Standard Duty	Heavy Duty	
6.0	6.0	Portland Cement Concrete, $f'_c=4000$ psi
4.0	6.0	Crushed Stone Base

Table 14: Rigid Pavement Recommendations

Notes: 1. All Paving operations should comply with minimum standards required by SCDOT

Please note that site specific traffic volume information would be required for specific pavement recommendations. All subgrade, base, and pavement construction operations should meet minimum requirements of the SCDOT Standard Specifications for Roads and Structures.

6.0 SUBGRADE REHABILITATION

The subgrade soils often become disturbed during the period between initial site grading and construction of surface improvements. The amount and depth of disturbance will vary with soil type, weather conditions, construction traffic, and drainage.

The engineer should evaluate the subgrade soil during final grading to verify that the subgrade is suitable to receive pavement and/or concrete slab base materials. The final evaluation may include proofrolling or density tests.

Subgrade rehabilitation can become a point of controversy when different contractors are responsible for site grading and building construction. The construction documents should specifically state which contractor will be responsible for maintaining and rehabilitating the subgrade. Rehabilitation may include moisture conditioning and re-compacting soils. When deadlines or weather restrict grading operations, additional measures such as undercutting and replacing saturated soils or chemical stabilization can often be utilized.

7.0 CONSTRUCTION MONITORING

Field verification of site conditions is an essential part of the services provided by the geotechnical consultant. In order to confirm our recommendations, it will be necessary for Building & Earth personnel to make periodic visits to the site during site grading. Typical construction monitoring services are listed below.

- Site stripping and subgrade evaluation
- Compaction Testing and Proofrolling for Structural Fill and Backfill Soils
- Compaction and Thickness Testing for Asphalt and Concrete Paving Materials
- Compaction and Thickness Testing for Aggregate Base Course Material

8.0 CLOSING AND LIMITATIONS

This preliminary report was prepared for Horry County Schools c/o ECLS Global, Inc., for specific application to the Horry County Schools Records Center site located on Church Street in Conway, South Carolina. The information in this report is not transferable. This report should not be used for a different development on the same property without first being evaluated by the engineer.

The recommendations in this report were based on the information obtained from our field exploration and laboratory analysis. The data collected is representative of the locations tested. Variations are likely to occur at other locations throughout the site. Engineering judgment was applied in regards to conditions between borings. It will be necessary to confirm the anticipated subsurface conditions during construction.

This report has been prepared in accordance with generally accepted standards of geotechnical engineering practice. No other warranty is expressed or implied. In the event that changes are made, or anticipated to be made, to the nature, design, or location of the project as outlined in this report, Building & Earth must be informed of the changes and given the opportunity to either verify or modify the conclusions of this report in writing, or the recommendations of this report will no longer be valid.

The scope of services for this project did not include any environmental assessment of the site or identification of pollutants or hazardous materials or conditions. If the owner is concerned about environmental issues Building & Earth would be happy to provide an additional scope of services to address those concerns.

This report is intended for use during design and preparation of specifications and may not address all conditions at the site during construction. Contractors reviewing this information should acknowledge that this document is for design information only.

An article published by the Geoprofessional Business Association (GBA), titled *Important Information About Your Geotechnical Report*, has been included in the Appendix. We encourage all individuals to become familiar with the article to help manage risk.

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GEOTECHNICAL INVESTIGATION METHODOLOGIES

The subsurface exploration, which is the basis of the recommendations of this report, has been performed in accordance with industry standards. Detailed methodologies employed in the investigation are presented in the following sections.

DUAL MASS DYNAMIC CONE PENETRATION TESTING (KESSLER DCP)

Dynamic Cone Penetration (DCP) tests were performed to estimate the in-place soil consistency and in-place California Bearing Ratio (CBR) of the subsurface soils by in-situ methods.

The DCP tests were performed starting at the top of existing subgrade to the desired depth of investigation. The DCP test was performed using the Kessler DCP with Dual Mass Hammer. A cone tip with base diameter of 0.79 inches and tip angle of 60 degrees was driven into the subsurface soils by a 17.6 pound (dual mass) sliding hammer from a height of 22.6 inches. The depth of cone penetration was measured at selected hammer drop intervals and the soil shear strength was reported in terms of DCP index. The DCP index is based on the average penetration depth resulting from one blow of the 17.6-pound hammer. The Kessler DCP can be used to estimate the strength characteristics of clay soils. The in-place CBR values of the subsurface soils at the test locations were estimated using empirical correlations between DCP index and California Bearing Ratio (CBR). The DCP test results are included in a subsequent section of the Appendix.

HAND AUGER BORINGS

Hand auger borings were drilled with a 4-inch diameter auger to advance the hole below the existing grade. A Building & Earth representative collected samples of the subsurface soils at regular depth intervals and at depths where a change in lithology occurred.

BORING LOG DESCRIPTION

Building & Earth Sciences, Inc. used the gINT software program to prepare the attached boring logs. The gINT program provides the flexibility to custom design the boring logs to include the pertinent information from the subsurface exploration and results of our laboratory analysis. The soil and laboratory information included on our logs is summarized below:

DEPTH AND ELEVATION

The depth below the ground surface and the corresponding elevation are shown in the first two columns.

SAMPLE TYPE

The method used to collect the sample is shown. The typical sampling methods include Split Spoon Sampling, Shelby Tube Sampling, Grab Samples, and Rock Core. A key is provided at the bottom of the log showing the graphic symbol for each sample type.

SAMPLE NUMBER

Each sample collected is numbered sequentially.

BLOWS PER INCREMENT, REC%, RQD%

When Standard Split Spoon sampling is used, the blows required to drive the sampler each 6-inch increment are recorded and shown in column 5. When rock core is obtained the recovery ratio (REC%) and Rock Quality Designation (RQD%) is recorded.

SOIL DATA

Column 6 is a graphic representation of four different soil parameters. Each of the parameters use the same graph, however, the values of the graph subdivisions vary with each parameter. Each parameter presented on column 6 is summarized below:

- **N-value**- The Standard Penetration Test N-value, obtained by adding the number of blows required to drive the sampler the final 12 inches, is recorded. The graph labels range from 0 to 50.
- **Qu** – Unconfined Compressive Strength estimate from the Pocket Penetrometer test in tons per square foot (tsf). The graph labels range from 0 to 5 tsf.
- **Atterberg Limits** – The Atterberg Limits are plotted with the plastic limit to the left, and liquid limit to the right, connected by a horizontal line. The difference in the plastic and liquid limits is referred to as the Plasticity Index. The Atterberg Limits test results are also included in the Remarks column on the far right of the boring log. The Atterberg Limits graph labels range from 0 to 100%.
- **Moisture** – The Natural Moisture Content of the soil sample as determined in our laboratory.

SOIL DESCRIPTION

The soil description prepared in accordance with ASTM D2488, Visual Description of Soil Samples. The Munsel Color chart is used to determine the soil color. Strata changes are indicated by a solid line, with the depth of the change indicated on the left side of the line and the elevation of the change indicated on the right side of the line. If subtle changes within a soil type occur, a broken line is used. The Boring Termination or Auger Refusal depth is shown as a solid line at the bottom of the boring.

GRAPHIC

The graphic representation of the soil type is shown. The graphic used for each soil type is related to the Unified Soil Classification chart. A chart showing the graphic associated with each soil classification is included.

REMARKS

Remarks regarding borehole observations, and additional information regarding the laboratory results and groundwater observations.

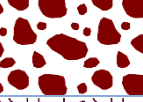


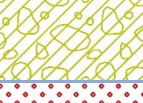
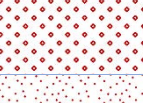
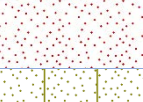
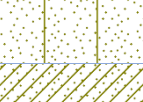
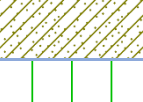
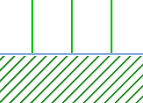
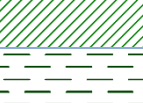
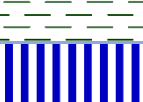
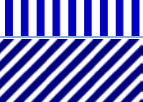

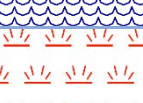

Major Divisions			Symbols		Group Name & Typical Description			
			Lithology	Group				
Coarse Grained Soils More than 50% of material is larger than No. 200 sieve size	Gravel and Gravelly Soils More than 50% of coarse fraction is larger than No. 4 sieve	Clean Gravels (Less than 5% fines)		GW	Well-graded gravels, gravel – sand mixtures, little or no fines			
				GP	Poorly-graded gravels, gravel – sand mixtures, little or no fines			
		Gravels with Fines (More than 12% fines)		GM	Silty gravels, gravel – sand – silt mixtures			
				GC	Clayey gravels, gravel – sand – clay mixtures			
	Sand and Sandy Soils More than 50% of coarse fraction is smaller than No. 4 sieve	Clean Sands (Less than 5% fines)		SW	Well-graded sands, gravelly sands, little or no fines			
				SP	Poorly-graded sands, gravelly sands, little or no fines			
		Sands with Fines (More than 12% fines)		SM	Silty sands, sand – silt mixtures			
				SC	Clayey sands, sand – clay mixtures			
			Fine Grained Soils More than 50% of material is smaller than No. 200 sieve size	Silts and Clays Liquid Limit less than 50	Inorganic		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silt with slight plasticity
							CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
Organic		OL			Organic silts and organic silty clays of low plasticity			
	Silts and Clays Liquid Limit greater than 50 sieve	Inorganic		MH	Inorganic silts, micaceous or diatomaceous fine sand, or silty soils			
			CH	Inorganic clays of high plasticity				
			OH	Organic clays of medium to high plasticity, organic silts				
Highly Organic Soils				PT	Peat, humus, swamp soils with high organic contents			

Table 1: Soil Classification Chart (based on ASTM D2487)

Building & Earth Sciences classifies soil in general accordance with the Unified Soil Classification System (USCS) presented in ASTM D2487. Table 1 and Figure 1 exemplify the general guidance of the USCS. Soil consistencies and relative densities are presented in general accordance with Terzaghi, Peck, & Mesri's (1996) method, as shown on Table 2, when quantitative field and/or laboratory data is available. Table 2 includes Consistency and Relative Density correlations with N-values obtained using either a manual hammer (60 percent efficiency) or automatic hammer (90 percent efficiency). The *Blows Per Increment* and *SPT N-values* displayed on the boring logs are the unaltered values measured in the field. When field and/or laboratory data is not available, we may classify soil in general accordance with the Visual Manual Procedure presented in ASTM D2488.

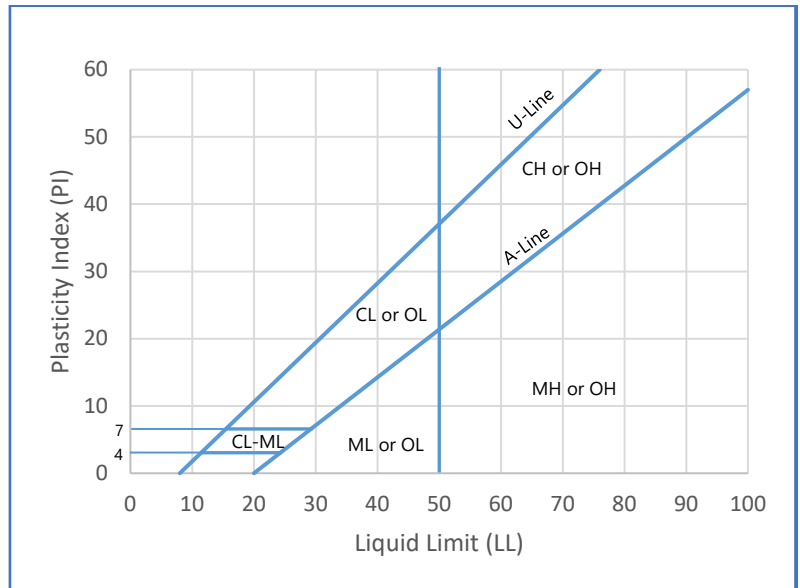


Figure 1: Plasticity Chart (based on ASTM D2487)

Non-cohesive: Coarse-Grained Soil		Cohesive: Fine-Grained Soil				
SPT Penetration (blows/foot)		Relative Density	SPT Penetration (blows/foot)		Consistency	Estimated Range of Unconfined Compressive Strength (tsf)
			Automatic Hammer*	Manual Hammer		
Automatic Hammer*	Manual Hammer		< 2	< 2	Very Soft	< 0.25
0 - 3	0 - 4	Very Loose	2 - 3	2 - 4	Soft	0.25 – 0.50
3 - 8	4 - 10	Loose	3 - 6	4 - 8	Medium Stiff	0.50 – 1.00
8 - 23	10 - 30	Medium Dense	6 - 12	8 - 15	Stiff	1.00 – 2.00
23 - 38	30 - 50	Dense	12 - 23	15 - 30	Very Stiff	2.00 – 4.00
> 38	> 50	Very Dense	> 23	> 30	Hard	> 4.00

Table 2: Soil Consistency and Relative Density (based on Terzaghi, Peck & Mesri, 1996)

* - Modified based on 80% hammer efficiency

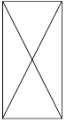



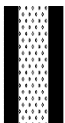



	Standard Penetration Test ASTM D1586 or AASHTO T-206		Dynamic Cone Penetrometer (Sower DCP) ASTM STP-399
	Shelby Tube Sampler ASTM D1587		No Sample Recovery
	Rock Core Sample ASTM D2113		Groundwater at Time of Drilling
	Auger Cuttings		Groundwater as Indicated

Table 1: Symbol Legend

Soil	Particle Size	U.S. Standard
Boulders	Larger than 300 mm	N.A.
Cobbles	300 mm to 75 mm	N.A.
Gravel	75 mm to 4.75 mm	3-inch to #4 sieve
Coarse	75 mm to 19 mm	3-inch to ¾-inch sieve
Fine	19 mm to 4.75 mm	¾-inch to #4 sieve
Sand	4.75 mm to 0.075 mm	#4 to #200 Sieve
Coarse	4.75 mm to 2 mm	#4 to #10 Sieve
Medium	2 mm to 0.425 mm	#10 to #40 Sieve
Fine	0.425 mm to 0.075 mm	#40 to #200 Sieve
Fines	Less than 0.075 mm	Passing #200 Sieve
Silt	Less than 5 µm	N.A.
Clay	Less than 2 µm	N.A.

Table 2: Standard Sieve Sizes





N-Value 	Standard Penetration Test Resistance calculated using ASTM D1586 or AASHTO T-206. Calculated as sum of original, field recorded values.	Atterberg Limits 	A measure of a soil's plasticity characteristics in general accordance with ASTM D4318. The soil Plasticity Index (PI) is representative of this characteristic and is bracketed by the Liquid Limit (LL) and the Plastic Limit (PL).
Qu 	Unconfined compressive strength, typically estimated from a pocket penetrometer. Results are presented in tons per square foot (tsf).	% Moisture 	Percent natural moisture content in general accordance with ASTM D2216.

Table 3: Soil Data

Hollow Stem Auger	Flights on the outside of the shaft advance soil cuttings to the surface. The hollow stem allows sampling through the middle of the auger flights.
Mud Rotary / Wash Bore	A cutting head advances the boring and discharges a drilling fluid to support the borehole and circulate cuttings to the surface.
Solid Flight Auger	Flights on the outside bring soil cuttings to the surface. Solid stem requires removal from borehole during sampling.
Hand Auger	Cylindrical bucket (typically 3-inch diameter and 8 inches long) attached to a metal rod and turned by human force.

Table 4: Soil Drilling Methods

Descriptor	Meaning
Trace	Likely less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

Table 5: Descriptors

Manual Hammer	The operator tightens and loosens the rope around a rotating drum assembly to lift and drop a sliding, 140-pound hammer falling 30 inches.
Automatic Trip Hammer	An automatic mechanism is used to lift and drop a sliding, 140-pound hammer falling 30 inches.
Dynamic Cone Penetrometer (Sower DCP) ASTM STP-399	Uses a 15-pound steel mass falling 20 inches to strike an anvil and cause penetration of a 1.5-inch diameter cone seated in the bottom of a hand augered borehole. The blows required to drive the embedded cone a depth of 1-3/4 inches have been correlated by others to N-values derived from the Standard Penetration Test (SPT).

Table 6: Sampling Methods

Non-plastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be re-rolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be re-rolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

Table 7: Plasticity

Dry	Absence of moisture, dusty, dry to the touch.
Moist	Damp but no visible water.
Wet	Visible free water, usually soil is below water table.

Table 8: Moisture Condition

Stratified	Alternating layers of varying material or color with layers at least 1/2 inch thick.
Laminated	Alternating layers of varying material or color with layers less than 1/4 inch thick.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing.
Slickensides	Fracture planes appear polished or glossy, sometimes striated.
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown.
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay.
Homogeneous	Same color and appearance throughout.

Table 9: Structure

Hatch	Description	Hatch	Description	Hatch	Description
	GW - Well-graded gravels, gravel – sand mixtures, little or no fines		Asphalt		Clay with Gravel
	GP - Poorly-graded gravels, gravel – sand mixtures, little or no fines		Aggregate Base		Sand with Gravel
	GM - Silty gravels, gravel – sand – silt mixtures		Topsoil		Silt with Gravel
	GC - Clayey gravels, gravel – sand – clay mixtures		Concrete		Gravel with Sand
	SW - Well-graded sands, gravelly sands, little or no fines		Coal		Gravel with Clay
	SP - Poorly-graded sands, gravelly sands, little or no fines		CL-ML - Silty Clay		Gravel with Silt
	SM - Silty sands, sand – silt mixtures		Sandy Clay		Limestone
	SC - Clayey sands, sand – clay mixtures		Clayey Chert		Chalk
	ML - Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silt with slight plasticity		Low and High Plasticity Clay		Siltstone
	CL - Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays		Low Plasticity Silt and Clay		Till
	OL - Organic silts and organic silty clays of low plasticity		High Plasticity Silt and Clay		Sandy Clay with Cobbles and Boulders
	MH - Inorganic silts, micaceous or diatomaceous fine sand, or silty soils		Fill		Sandstone with Shale
	CH - Inorganic clays of high plasticity		Weathered Rock		Coral
	OH - Organic clays of medium to high plasticity, organic silts		Sandstone		Boulders and Cobbles
	PT - Peat, humus, swamp soils with high organic contents		Shale		Soil and Weathered Rock

Table 1: Key to Hatches Used for Boring Logs and Soil Profiles

BORING LOCATION PLAN



 Approximate Boring Location



Test Location Map


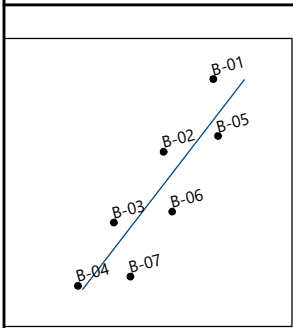
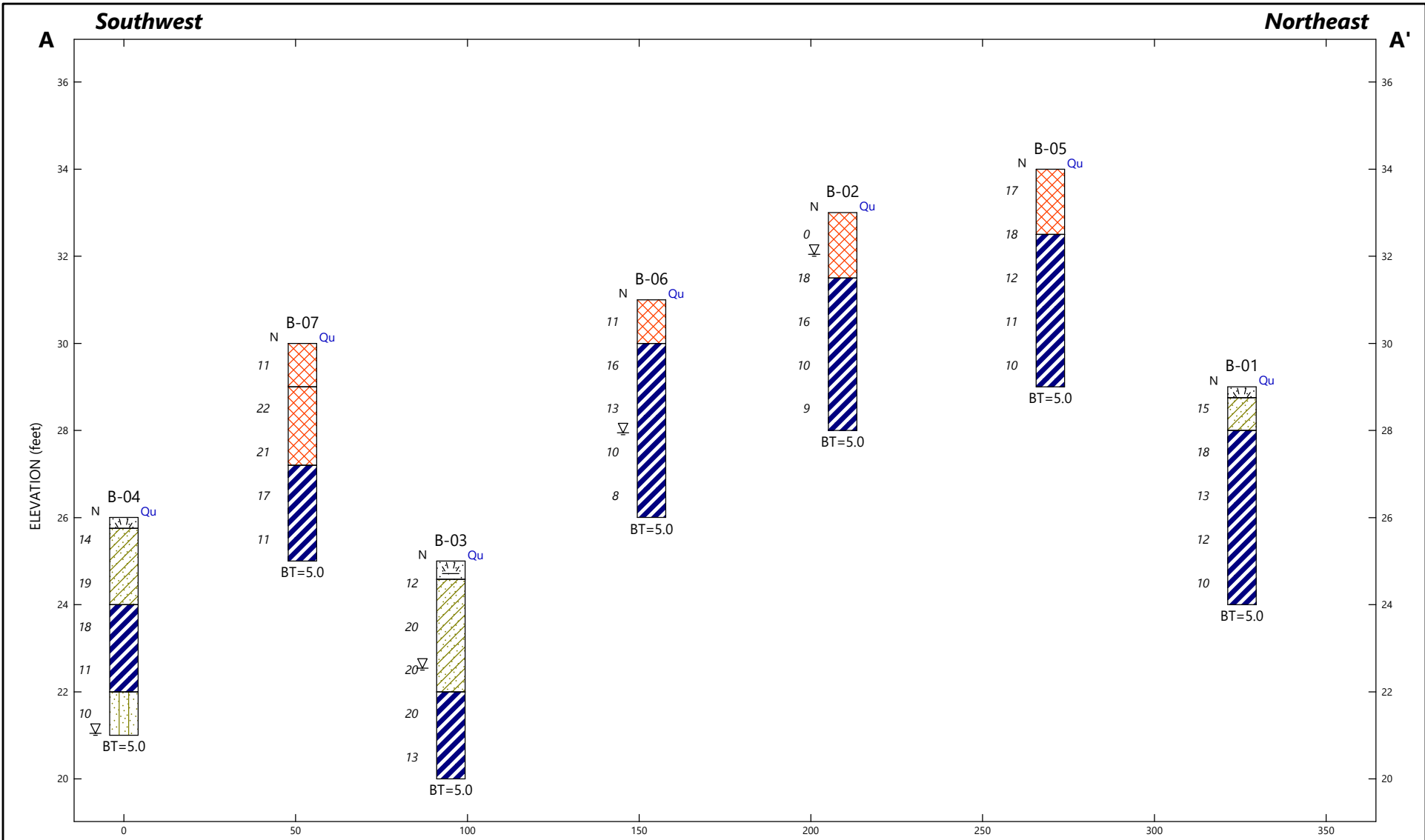
BES Project #:	RD200105	Client:	ECLS Global, Inc
Drawing Source:	Google Earth Imagery	Project:	Horry County Schools – Records Center
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		City:	Conway, South Carolina

Figure 1

SUBSURFACE PROFILES



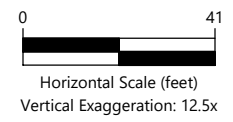
Site Map Scale 1 inch equals 255 feet

Key to Hatches

	Topsoil		USCS Clayey Sand		USCS High Plasticity Clay
	Fill		USCS Silty Sand		

Legend

BT=Boring Termination, TPT=Test Pit Terminated
 AR=Auger Refusal, ER=Excavation Refusal
 N=Standard Penetration Test N-Value
 Qu=Unconfined compressive strength estimate from pocket penetrometer test (tsf)
 Water Level Reading at time of drilling.
 Water Level Reading after drilling.



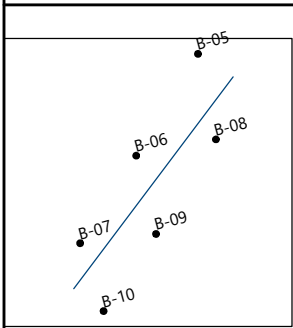
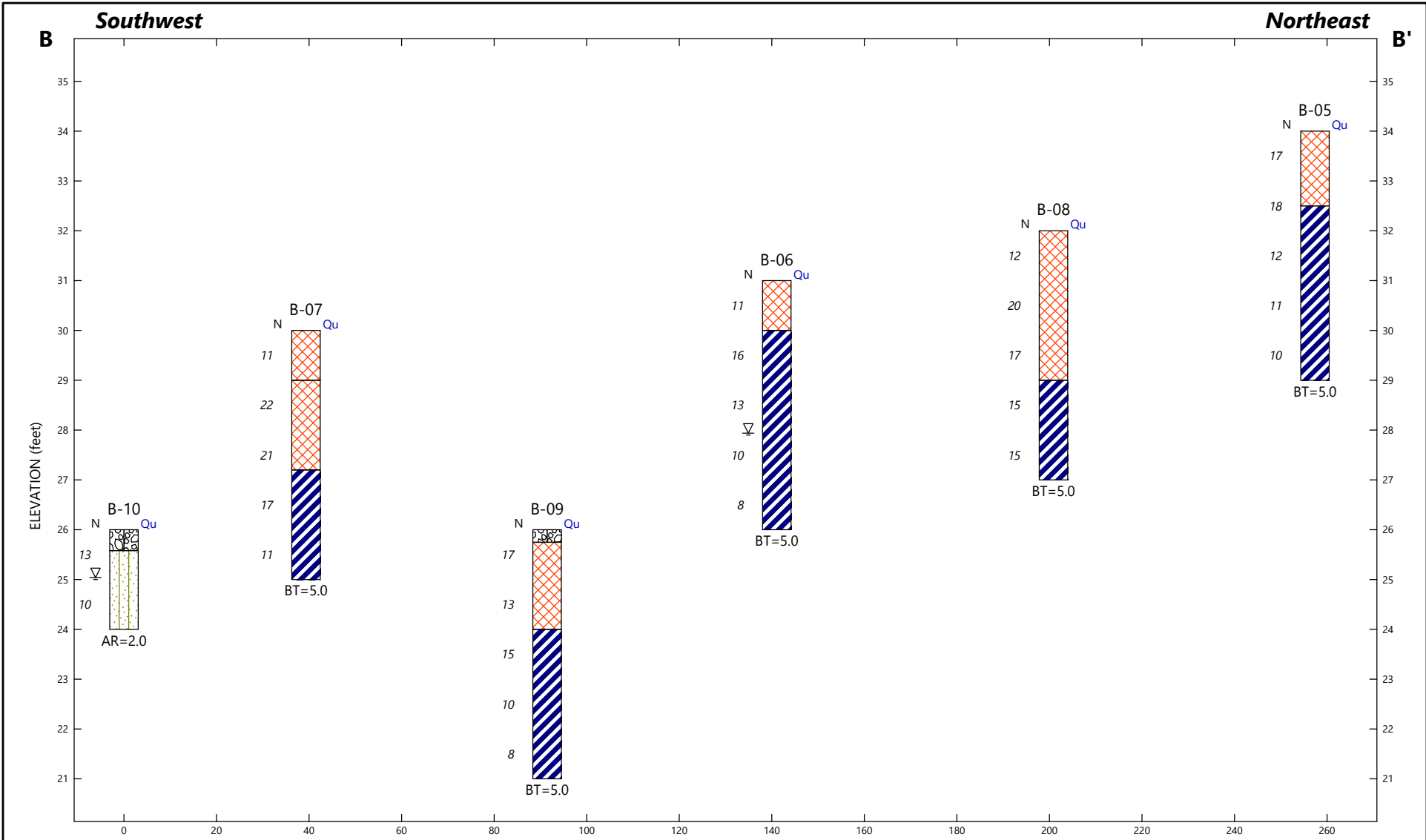
Building & Earth Sciences, Inc.
 610 Spring Branch Road, Dunn, NC, 28334

Horry County School - Records Center
 Conway, SC

Section A-A': Subsurface Profile
Figure 1

PROJECT NO: RD200105	PLATE NO: A-1	DATE: 3/16/20
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Geotechnical, Environmental, and Materials Engineers



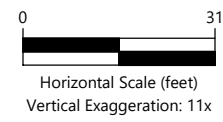
Site Map Scale 1 inch equals 190 feet

Key to Hatches

- Fill
- USCS High Plasticity Clay
- USCS Silty Sand
- Aggregate Base Material

Legend

- BT=Boring Termination, TPT=Test Pit Terminated
- AR=Auger Refusal, ER=Excavation Refusal
- N=Standard Penetration Test N-Value
- Qu=Unconfined compressive strength estimate from pocket penetrometer test (tsf)
- Water Level Reading at time of drilling.
- Water Level Reading after drilling.



Building & Earth Sciences, Inc.

610 Spring Branch Road, Dunn, NC, 28334

Horry County School - Records Center
Conway, SC

**Section B-B': Subsurface Profile
Figure 2**

PROJECT NO: RD200105	PLATE NO: A-1	DATE: 3/16/20
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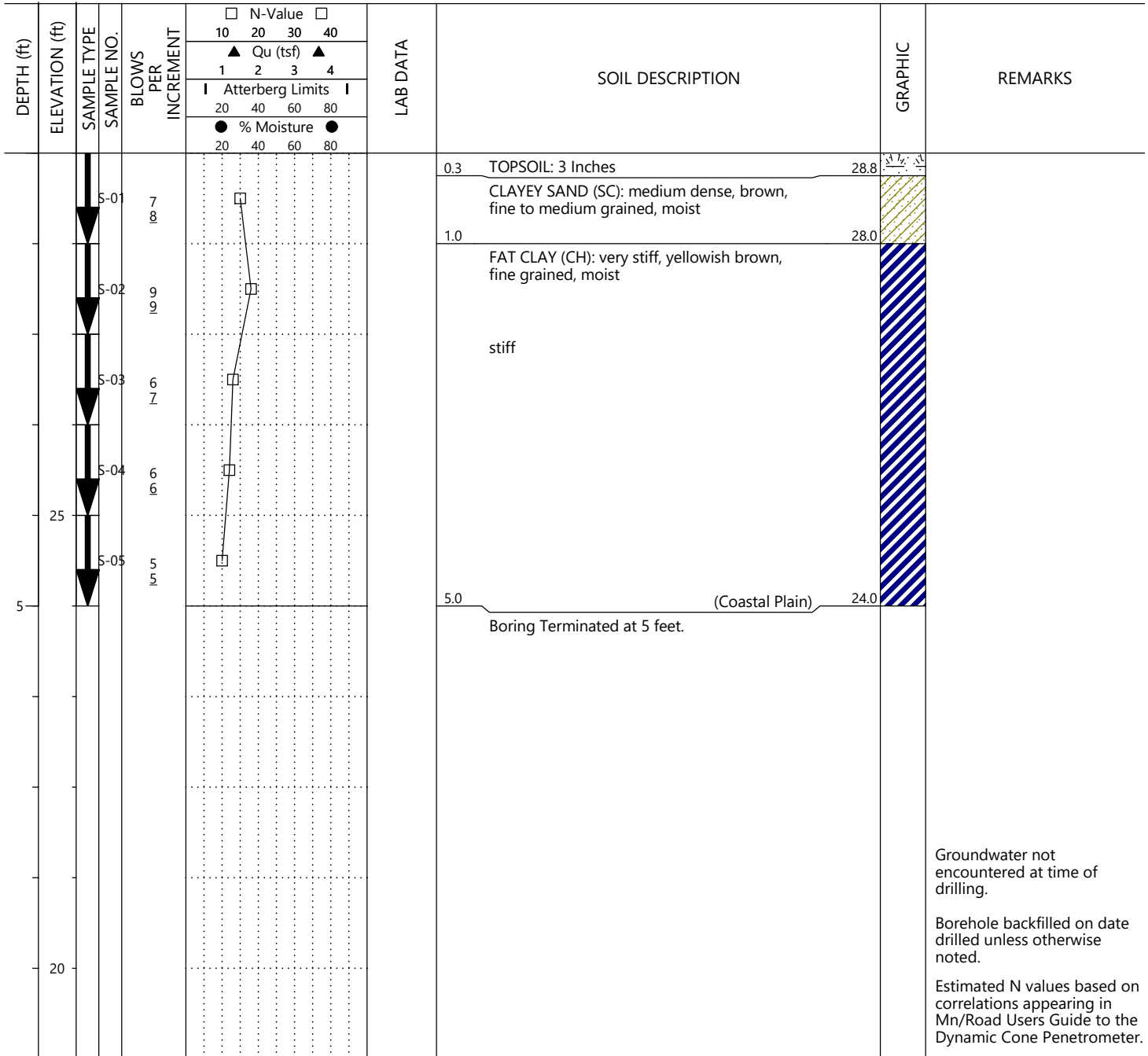


Geotechnical, Environmental, and Materials Engineers

BORING LOGS

PROJECT NAME: Horry County School - Records Center
PROJECT NUMBER: RD200105
DRILLING METHOD: Hand Auger
EQUIPMENT USED: Kessler DCP
HAMMER TYPE: Manual
BORING LOCATION: See Boring Location Map

LOCATION: Conway, SC
DATE DRILLED: 2/27/20
WEATHER: 44 Degrees, Sunny
ELEVATION: 29
DRILL CREW: Building & Earth Sciences
LOGGED BY: M.Lumpkin



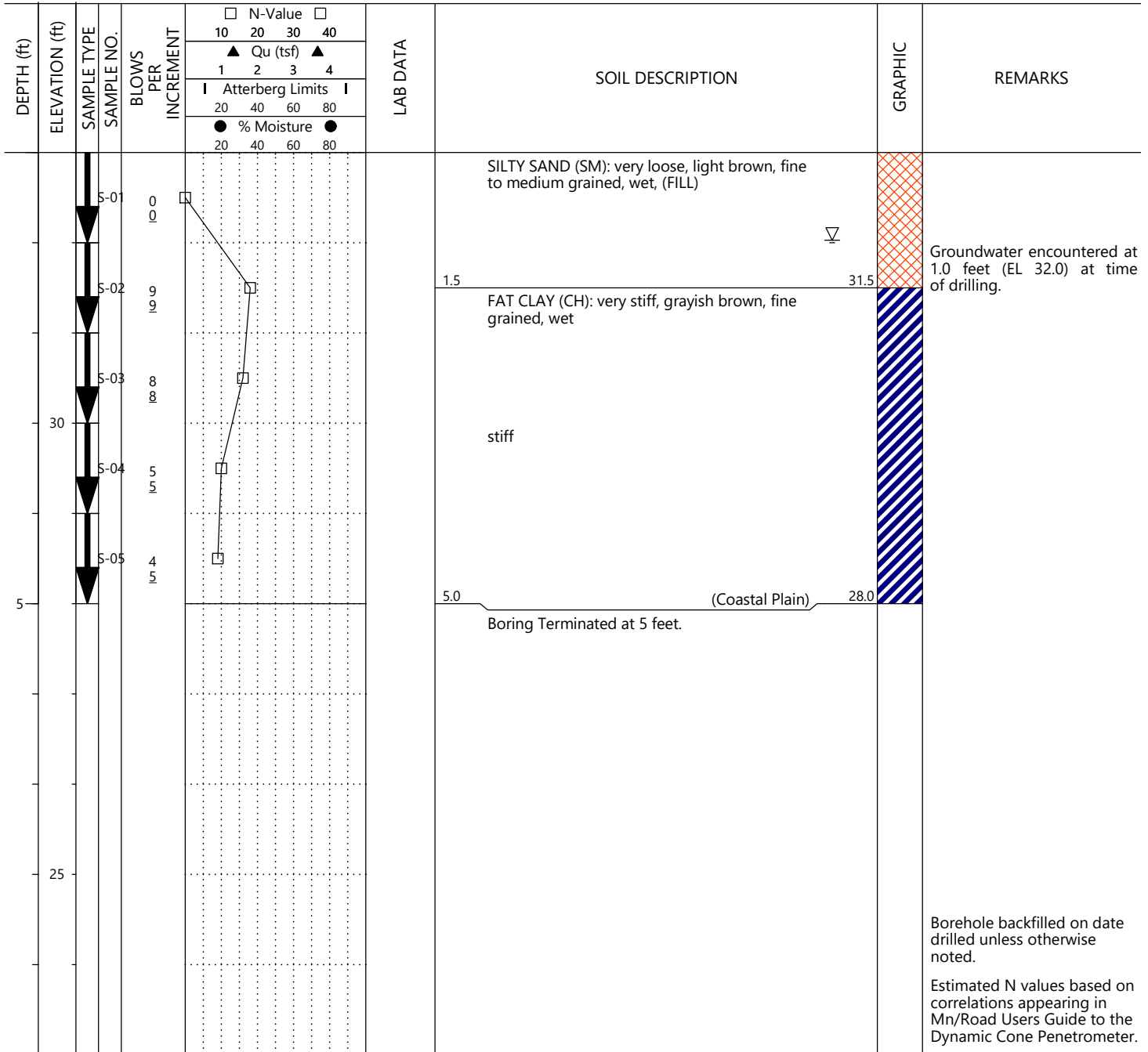
Groundwater not encountered at time of drilling.
Borehole backfilled on date drilled unless otherwise noted.
Estimated N values based on correlations appearing in Mn/Road Users Guide to the Dynamic Cone Penetrometer.

SAMPLE TYPE THD Cone Penetration

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206) **REC** RECOVERY **LL:** LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT
% MOISTURE PERCENT NATURAL MOISTURE CONTENT **RQD** ROCK QUALITY DESIGNATION **PL:** PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE
 GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING **UD** UNDISTURBED **PI:** PLASTICITY INDEX
 STABILIZED GROUNDWATER LEVEL **Qu** POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

PROJECT NAME: Horry County School - Records Center
PROJECT NUMBER: RD200105
DRILLING METHOD: Hand Auger
EQUIPMENT USED: Kessler DCP
HAMMER TYPE: Manual
BORING LOCATION: See Boring Location Map

LOCATION: Conway, SC
DATE DRILLED: 2/27/20
WEATHER: 44 Degrees, Sunny
ELEVATION: 33
DRILL CREW: Building & Earth Sciences
LOGGED BY: M.Lumpkin



SAMPLE TYPE THD Cone Penetration

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206) **REC** RECOVERY **LL:** LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT
% MOISTURE PERCENT NATURAL MOISTURE CONTENT **RQD** ROCK QUALITY DESIGNATION **PL:** PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE
 GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING **UD** UNDISTURBED **PI:** PLASTICITY INDEX
 STABILIZED GROUNDWATER LEVEL **Qu** POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

PROJECT NAME: Horry County School - Records Center
PROJECT NUMBER: RD200105
DRILLING METHOD: Hand Auger
EQUIPMENT USED: Kessler DCP
HAMMER TYPE: Manual
BORING LOCATION: See Boring Location Map

LOCATION: Conway, SC
DATE DRILLED: 2/27/20
WEATHER: 44 Degrees, Sunny
ELEVATION: 25
DRILL CREW: Building & Earth Sciences
LOGGED BY: M.Lumpkin

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	LAB DATA		SOIL DESCRIPTION	GRAPHIC	REMARKS
					N-Value	Qu (tsf)			
25	25						TOPSOIL: 5 Inches		
6	24.6	S-01	6	6	10		CLAYEY SAND (SC): medium dense, brown, fine to medium grained, moist		
10	24.6	S-02	10	10	20				
10	22.0	S-03	10	10	30		FAT CLAY (CH): very stiff, reddish brown, fine grained, wet		Groundwater encountered at 2.5 feet (EL 22.5) at time of drilling.
10	22.0	S-04	10	10	40		stiff		
6	20.0	S-05	6	7	80		(Coastal Plain)		
5.0	20.0						Boring Terminated at 5 feet.		
15									Borehole backfilled on date drilled unless otherwise noted.
									Estimated N values based on correlations appearing in Mn/Road Users Guide to the Dynamic Cone Penetrometer.

SAMPLE TYPE THD Cone Penetration



- N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206) REC RECOVERY LL: LIQUID LIMIT M: NATURAL MOISTURE CONTENT
- % MOISTURE PERCENT NATURAL MOISTURE CONTENT RQD ROCK QUALITY DESIGNATION PL: PLASTIC LIMIT F: PERCENT PASSING NO. 200 SIEVE
- ▽ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING UD UNDISTURBED PI: PLASTICITY INDEX
- ▾ STABILIZED GROUNDWATER LEVEL Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

PROJECT NAME: Horry County School - Records Center
PROJECT NUMBER: RD200105
DRILLING METHOD: Hand Auger
EQUIPMENT USED: Kessler DCP
HAMMER TYPE: Manual
BORING LOCATION: See Boring Location Map

LOCATION: Conway, SC
DATE DRILLED: 2/21/20
WEATHER: 37 Degrees , Partly Cloudy
ELEVATION: 26
DRILL CREW: Building & Earth Sciences
LOGGED BY: M.Lumpkin

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	LAB DATA				SOIL DESCRIPTION	GRAPHIC	REMARKS
					□ N-Value □	▲ Qu (tsf) ▲	Atterberg Limits				
					10 20 30 40	1 2 3 4	20 40 60 80	20 40 60 80			
0.3	25.8							TOPSOIL: 3 inches			
			S-01	7				CLAYEY SAND (SC): medium dense, brown, fine to medium grained, moist			
								reddish brown			
			S-02	9							
				10				FAT CLAY (CH): very stiff, gray, fine grained, moist			
			S-03	9							
				9				stiff			
			S-04	5							
				6				SILTY SAND (SM): medium dense, light brown, fine to medium grained, wet			
			S-05	5							
				5							
5.0	21.0							(Coastal Plain)		Groundwater encountered at 5.0 feet (EL 21.0) at time of drilling.	
								Boring Terminated at 5 feet.			

SAMPLE TYPE  THD Cone Penetration

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206) **REC** RECOVERY **LL:** LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT
% MOISTURE PERCENT NATURAL MOISTURE CONTENT **RQD** ROCK QUALITY DESIGNATION **PL:** PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE
 GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING **UD** UNDISTURBED **PI:** PLASTICITY INDEX
 STABILIZED GROUNDWATER LEVEL **Qu** POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

PROJECT NAME: Horry County School - Records Center
PROJECT NUMBER: RD200105
DRILLING METHOD: Hand Auger
EQUIPMENT USED: Kessler DCP
HAMMER TYPE: Manual
BORING LOCATION: See Boring Location Map

LOCATION: Conway, SC
DATE DRILLED: 2/21/20
WEATHER: 37 Degrees , Partly Cloudy
ELEVATION: 34
DRILL CREW: Building & Earth Sciences
LOGGED BY: M.Lumpkin

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	LAB DATA				SOIL DESCRIPTION	GRAPHIC	REMARKS
					□ N-Value □	▲ Qu (tsf) ▲	Atterberg Limits				
					10 20 30 40	1 2 3 4	20 40 60 80	20 40 60 80			
8	26	THD	S-01	8	10	1	17.2	17.2	SILTY SAND (SM): medium dense, brown, fine to medium grained, moist, (FILL)	[Orange Cross-hatch]	Sample S-01 M: 17.2%
9	25	THD	S-02	9	10	1	19.6	19.6			
6	28	THD	S-03	6	10	1	24.3	54	FAT CLAY (CH): very stiff, gray, brown, fine grained, moist stiff gray, reddish brown	[Blue Diagonal Lines]	Sample S-03 LL: 50 PL: 20 PI: 30 M: 24.3% F: 54%
5	29	THD	S-04	5	10	1	24.8	24.8			
5	29	THD	S-05	5	10	1			Boring Terminated at 5 feet.	[White]	Sample S-04 M: 24.8%
<p>5.0 (Coastal Plain) 29.0</p>											

Groundwater not encountered at time of drilling.
Borehole backfilled on date drilled unless otherwise noted.
Estimated N values based on correlations appearing in Mn/Road Users Guide to the Dynamic Cone Penetrometer.

SAMPLE TYPE THD Cone Penetration



N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206) **REC** RECOVERY **LL:** LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT
% MOISTURE PERCENT NATURAL MOISTURE CONTENT **RQD** ROCK QUALITY DESIGNATION **PL:** PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE
 GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING **UD** UNDISTURBED **PI:** PLASTICITY INDEX
 STABILIZED GROUNDWATER LEVEL **Qu** POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

PROJECT NAME: Horry County School - Records Center
PROJECT NUMBER: RD200105
DRILLING METHOD: Hand Auger
EQUIPMENT USED: Kessler DCP
HAMMER TYPE: Manual
BORING LOCATION: See Boring Location Map

LOCATION: Conway, SC
DATE DRILLED: 2/27/20
WEATHER: 44 Degrees, Sunny
ELEVATION: 31
DRILL CREW: Building & Earth Sciences
LOGGED BY: M.Lumpkin

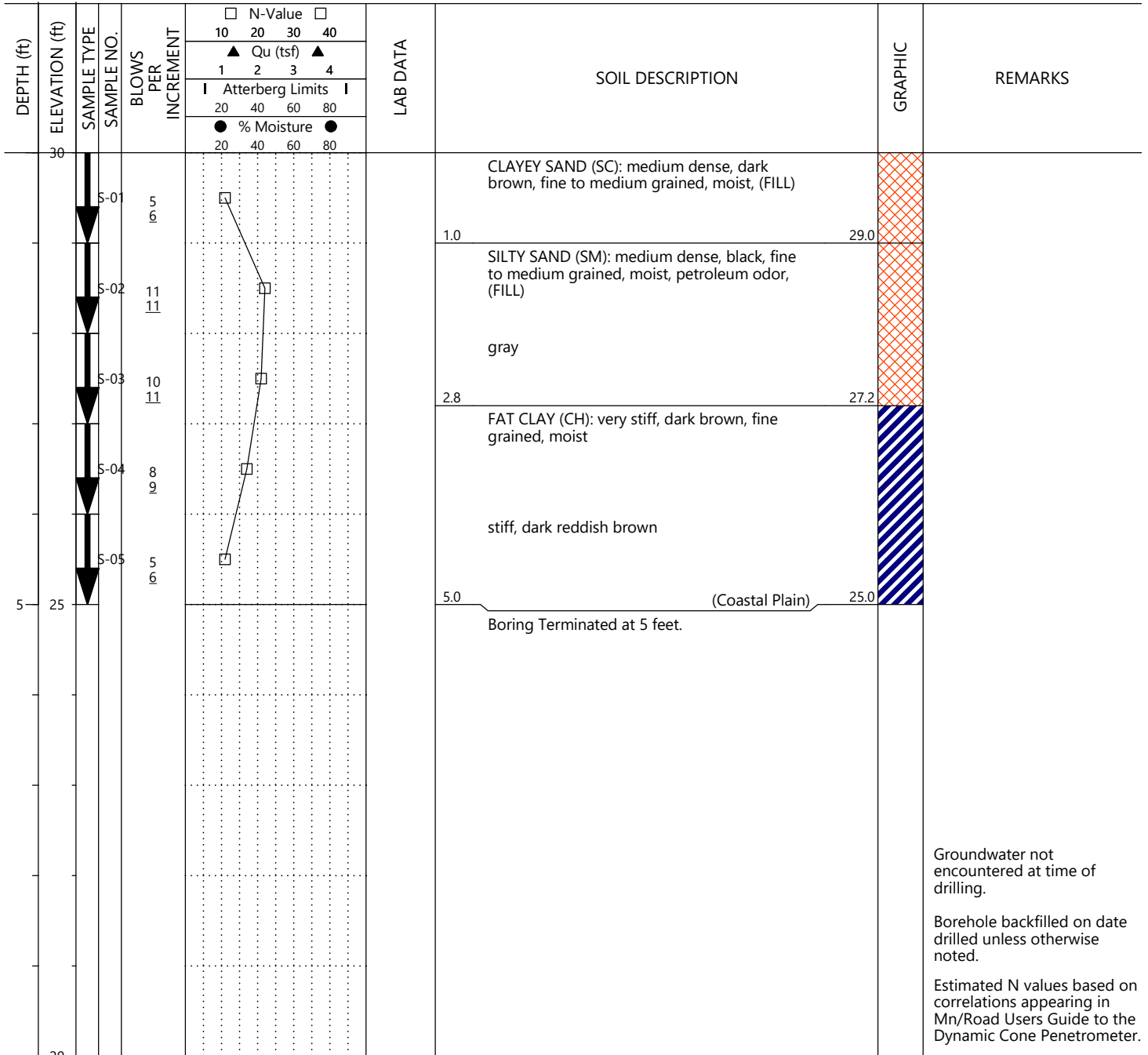
DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	LAB DATA				SOIL DESCRIPTION	GRAPHIC	REMARKS
					□ N-Value □	▲ Qu (tsf) ▲	Atterberg Limits				
					10 20 30 40	1 2 3 4	20 40 60 80	20 40 60 80			
30	30	THD Cone Penetration	S-01	5					SILTY SAND (SM): medium dense, reddish brown, fine to medium grained, moist, (FILL)		
			S-02	8					FAT CLAY (CH): very stiff, grayish brown, fine grained, moist		
			S-03	6					stiff		
			S-04	5					wet	▽	Groundwater encountered at 3.1 feet (EL 27.9) at time of drilling.
			S-05	4					Boring Terminated at 5 feet.		
5	26.0								(Coastal Plain)		
25											Borehole backfilled on date drilled unless otherwise noted. Estimated N values based on correlations appearing in Mn/Road Users Guide to the Dynamic Cone Penetrometer.

SAMPLE TYPE  THD Cone Penetration

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206) **REC** RECOVERY **LL:** LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT
% MOISTURE PERCENT NATURAL MOISTURE CONTENT **RQD** ROCK QUALITY DESIGNATION **PL:** PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE
 GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING **UD** UNDISTURBED **PI:** PLASTICITY INDEX
 STABILIZED GROUNDWATER LEVEL **Qu** POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

PROJECT NAME: Horry County School - Records Center
PROJECT NUMBER: RD200105
DRILLING METHOD: Hand Auger
EQUIPMENT USED: Kessler DCP
HAMMER TYPE: Manual
BORING LOCATION: See Boring Location Map

LOCATION: Conway, SC
DATE DRILLED: 2/21/20
WEATHER: 37 Degrees , Partly Cloudy
ELEVATION: 30
DRILL CREW: Building & Earth Sciences
LOGGED BY: M.Lumpkin



SAMPLE TYPE THD Cone Penetration

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206) **REC** RECOVERY **LL:** LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT
% MOISTURE PERCENT NATURAL MOISTURE CONTENT **RQD** ROCK QUALITY DESIGNATION **PL:** PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE
 GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING **UD** UNDISTURBED **PI:** PLASTICITY INDEX
 STABILIZED GROUNDWATER LEVEL **Qu** POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

Groundwater not encountered at time of drilling.
Borehole backfilled on date drilled unless otherwise noted.
Estimated N values based on correlations appearing in Mn/Road Users Guide to the Dynamic Cone Penetrometer.

PROJECT NAME: Horry County School - Records Center
 PROJECT NUMBER: RD200105
 DRILLING METHOD: Hand Auger
 EQUIPMENT USED: Kessler DCP
 HAMMER TYPE: Manual
 BORING LOCATION: See Boring Location Map

LOCATION: Conway, SC
 DATE DRILLED: 2/21/20
 WEATHER: 37 Degrees , Partly Cloudy
 ELEVATION: 32
 DRILL CREW: Building & Earth Sciences
 LOGGED BY: M.Lumpkin

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	LAB DATA				SOIL DESCRIPTION	GRAPHIC	REMARKS
					□ N-Value □	▲ Qu (tsf) ▲	Atterberg Limits				
					10 20 30 40	1 2 3 4	20 40 60 80	20 40 60 80			
6	26	THD	S-01	6	10	2	60	60	CLAYEY SAND (SC): medium dense, brown, fine to medium grained, moist, (FILL)		
10	22	THD	S-02	10	10	3	60				
8	24	THD	S-03	8	10	3	60				
7	25	THD	S-04	7	10	3	60				
7	25	THD	S-05	7	10	3	60				
3.0	29.0							FAT CLAY (CH): stiff, reddish brown, fine grained, moist			
5.0	27.0							(Coastal Plain)			
Boring Terminated at 5 feet.											

Groundwater not encountered at time of drilling.
 Borehole backfilled on date drilled unless otherwise noted.
 Estimated N values based on correlations appearing in Mn/Road Users Guide to the Dynamic Cone Penetrometer.

SAMPLE TYPE THD Cone Penetration

- | | | |
|---|--|--|
| N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206) | REC RECOVERY | LL: LIQUID LIMIT M: NATURAL MOISTURE CONTENT |
| % MOISTURE PERCENT NATURAL MOISTURE CONTENT | RQD ROCK QUALITY DESIGNATION PL: PLASTIC LIMIT F: PERCENT PASSING NO. 200 SIEVE | |
| GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING | UD UNDISTURBED | PI: PLASTICITY INDEX |
| STABILIZED GROUNDWATER LEVEL | Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH | |

PROJECT NAME: Horry County School - Records Center
PROJECT NUMBER: RD200105
DRILLING METHOD: Hand Auger
EQUIPMENT USED: Kessler DCP
HAMMER TYPE: Manual
BORING LOCATION: See Boring Location Map

LOCATION: Conway, SC
DATE DRILLED: 2/21/20
WEATHER: 37 Degrees , Partly Cloudy
ELEVATION: 26
DRILL CREW: Building & Earth Sciences
LOGGED BY: M.Lumpkin

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	LAB DATA				SOIL DESCRIPTION	GRAPHIC	REMARKS
					□ N-Value □	▲ Qu (tsf) ▲	Atterberg Limits				
					10 20 30 40	1 2 3 4	20 40 60 80	20 40 60 80			
0.3									AGGREGATE BASE: 3 Inches	25.8	
25		S-01		8					CLAYEY SAND (SC): medium dense, brown, fine to medium grained, moist, (FILL)		
				9					Gravel		
		S-02		6							Sample S-02 M: 9.6%
				7							
		S-03		7							Sample S-03 M: 18.0%
				8							
		S-04		5							Sample S-04 LL: 61 PL: 26 PI: 35 M: 25.7% F: 64%
				5							
		S-05		4							Sample S-05 M: 23.7%
				4							
5									(Coastal Plain)	21.0	
									Boring Terminated at 5 feet.		
20											

Groundwater not encountered at time of drilling.
Borehole backfilled on date drilled unless otherwise noted.
Estimated N values based on correlations appearing in Mn/Road Users Guide to the Dynamic Cone Penetrometer.

SAMPLE TYPE THD Cone Penetration

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206) **REC** RECOVERY **LL:** LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT
% MOISTURE PERCENT NATURAL MOISTURE CONTENT **RQD** ROCK QUALITY DESIGNATION **PL:** PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE
 GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING **UD** UNDISTURBED **PI:** PLASTICITY INDEX
 STABILIZED GROUNDWATER LEVEL **Qu** POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

PROJECT NAME: Horry County School - Records Center
 PROJECT NUMBER: RD200105
 DRILLING METHOD: Hand Auger
 EQUIPMENT USED: Kessler DCP
 HAMMER TYPE: Manual
 BORING LOCATION: See Boring Location Map

LOCATION: Conway, SC
 DATE DRILLED: 2/21/20
 WEATHER: 37 Degrees , Partly Cloudy
 ELEVATION: 26
 DRILL CREW: Building & Earth Sciences
 LOGGED BY: M.Lumpkin

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	LAB DATA				SOIL DESCRIPTION	GRAPHIC	REMARKS
					□ N-Value □	▲ Qu (tsf) ▲	Atterberg Limits				
					10 20 30 40	1 2 3 4	20 40 60 80	20 40 60 80			
0.4	25.6			6					AGGREGATE BASE: 5 inches		
2.0	24.0			5					SILTY SAND (SM): medium dense, brown, fine to medium grained, moist, (FILL) wet (Coastal Plain)	Groundwater encountered at 1.0 feet (EL 25.0) at time of drilling.	
2.0									Auger Refusal at 2 feet.		

SAMPLE TYPE THD Cone Penetration

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206) **REC** RECOVERY **LL:** LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT
% MOISTURE PERCENT NATURAL MOISTURE CONTENT **RQD** ROCK QUALITY DESIGNATION **PL:** PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE
 GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING **UD** UNDISTURBED **PI:** PLASTICITY INDEX
 STABILIZED GROUNDWATER LEVEL **Qu** POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

KESSLER DYNAMIC CONE PENETROMETER (In Situ CBR) RESULTS



Dynamic Cone Penetrometer (In situ CBR) - ASTM D 6951

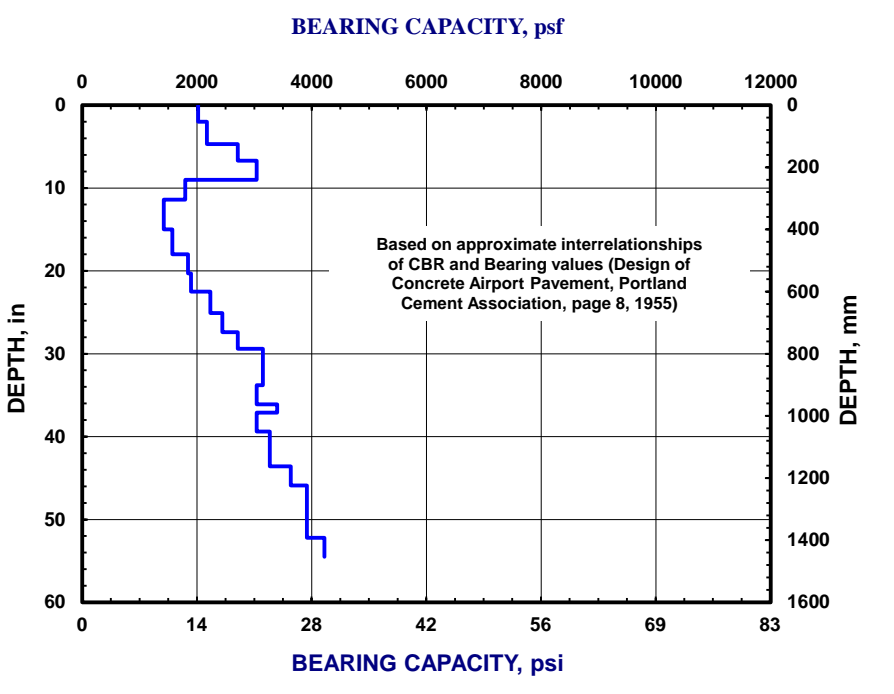
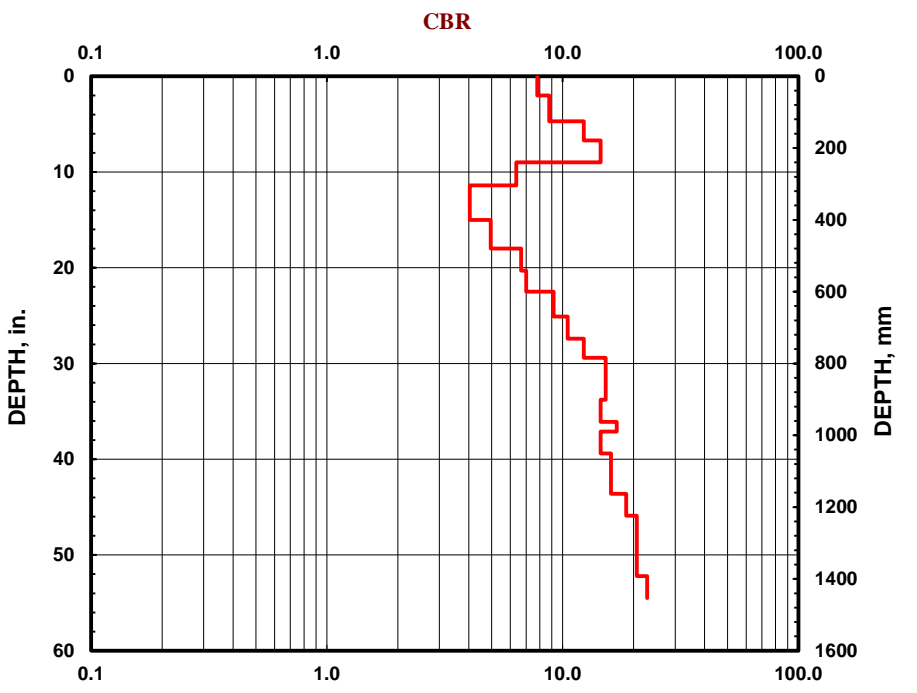
Project: Horry County Schools - Records Center
Client: ECLS Global, Inc
Technician: M. Lumpkin

Date: 02/21/20
Soil Type(s): SC, CH
Location: B-01

Hammer
 10.1 lbs. - (2)
 17.6 lbs. - (1)
 Both hammers used

Soil Type
 CH
 CL
 All other soils

No. of Blows	Accumulative Penetration (mm)	SM, CH+C41:C5 Blow Factor
0	0	1
2	51	1
3	119	1
3	170	1
4	229	1
2	290	1
2	381	1
2	457	1
2	516	1
2	572	1
3	638	1
3	696	1
3	747	1
4	803	1
4	859	1
4	917	1
2	942	1
4	1001	1
4	1054	1
4	1107	1
5	1166	1
5	1219.2	1
5	1273	1
5	1326	1
6	1384	1





Geotechnical, Environmental, and Materials Engineers

Dynamic Cone Penetrometer (In situ CBR) - ASTM D 6951

Project:	Horry County Schools - Records Center	Date: 02/21/20
Client:	ECLS Global, Inc	Soil Type(s): SM, CH
Technician:	M. Lumpkin	Location: B-02

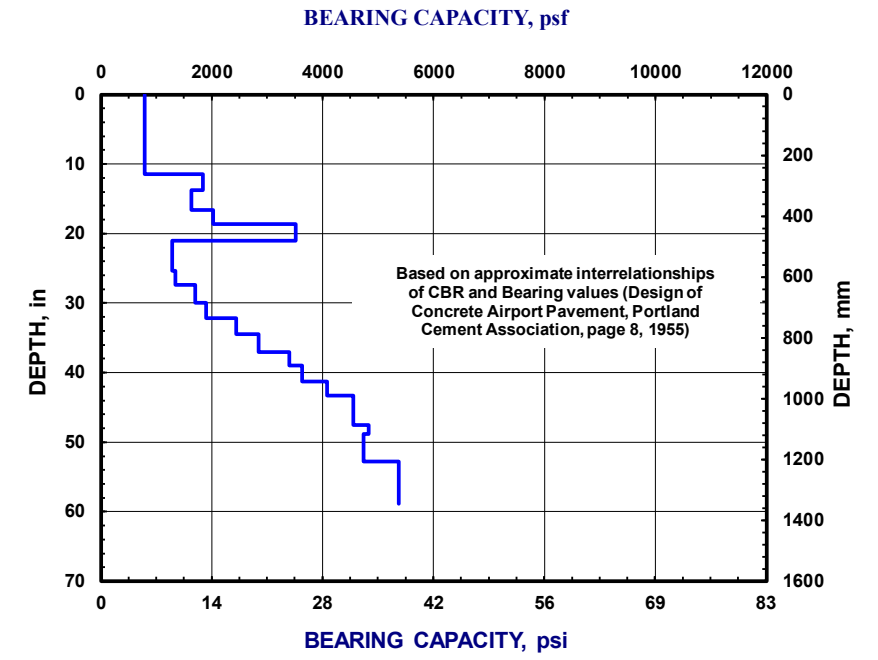
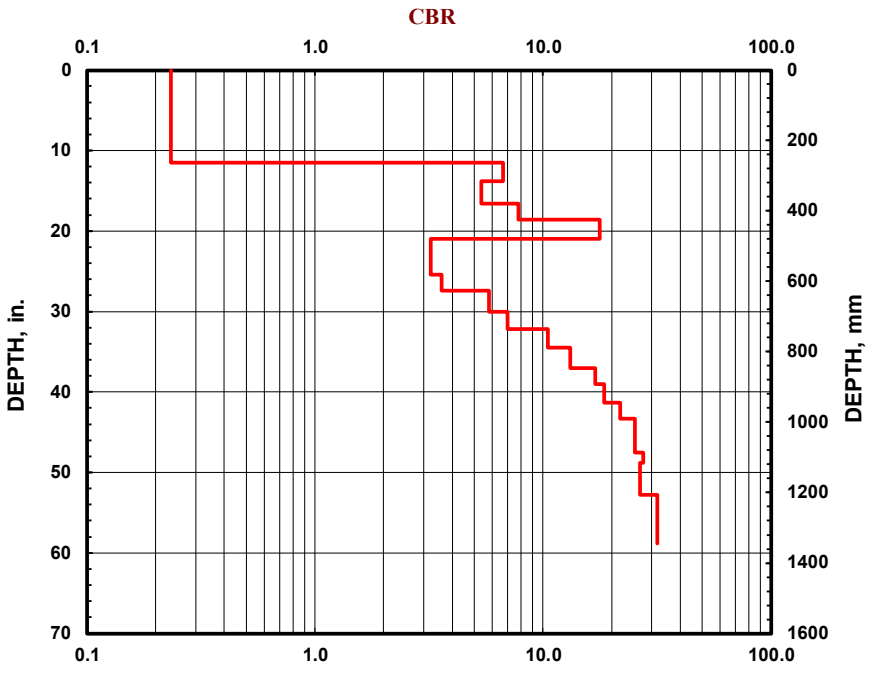
Hammer

- 10.1 lbs. - (2)
- 17.6 lbs. - (1)
- Both hammers used

Soil Type

- CH
- CL
- All other soils

No. of Blows	Accumulative Penetration (mm)	Hammer Blow Factor
0	0	1
0.5	292	1
2	351	1
2	422	1
2	472	1
5	533	1
2	645	1
1	696	1
2	762	1
2	818	1
3	876	1
4	940	1
4	991	1
5	1049	1
5	1100	1
6	1153	1
6	1207	1
4	1240	1
6	1290	1
6	1341	1
7	1392	1
7	1443	1
7	1494	1



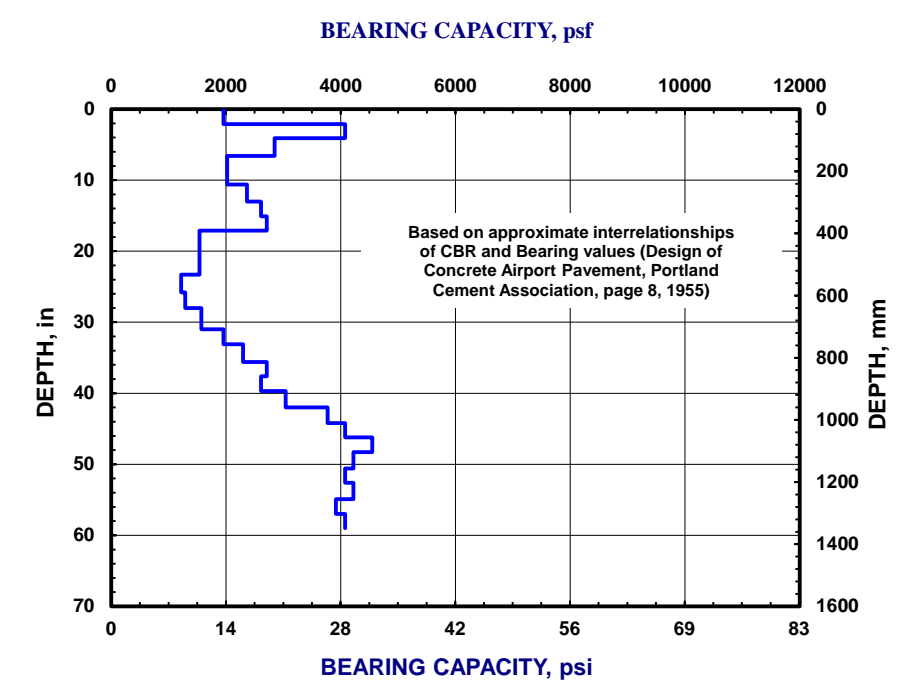
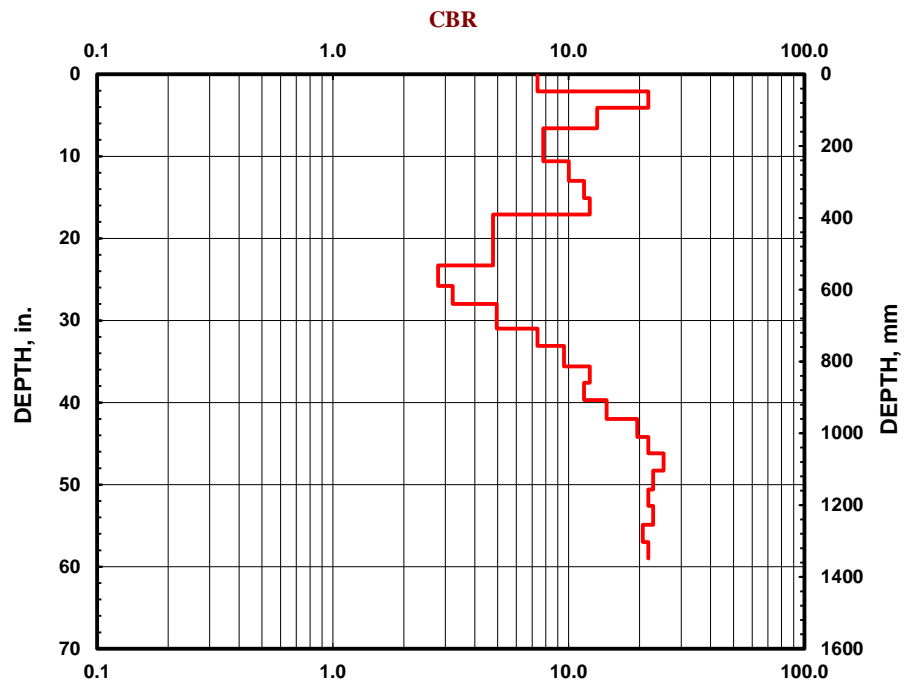
Dynamic Cone Penetrometer (In situ CBR) - ASTM D 6951

Project: Horry County Schools - Records Center Date: 02/21/20
Client: ECLS Global, Inc Soil Type(s): SC, CH, SM
Technician: M. Lumpkin Location: B-04

Hammer
o 10.1 lbs. - (2)
o 17.6 lbs. - (1)
● Both hammers used

Soil Type
o CH
o CL
● All other soils

Table with 3 columns: No. of Blows, Accumulative Penetration (mm), Hammer Blow Factor. Contains 20 rows of data.





Geotechnical, Environmental, and Materials Engineers

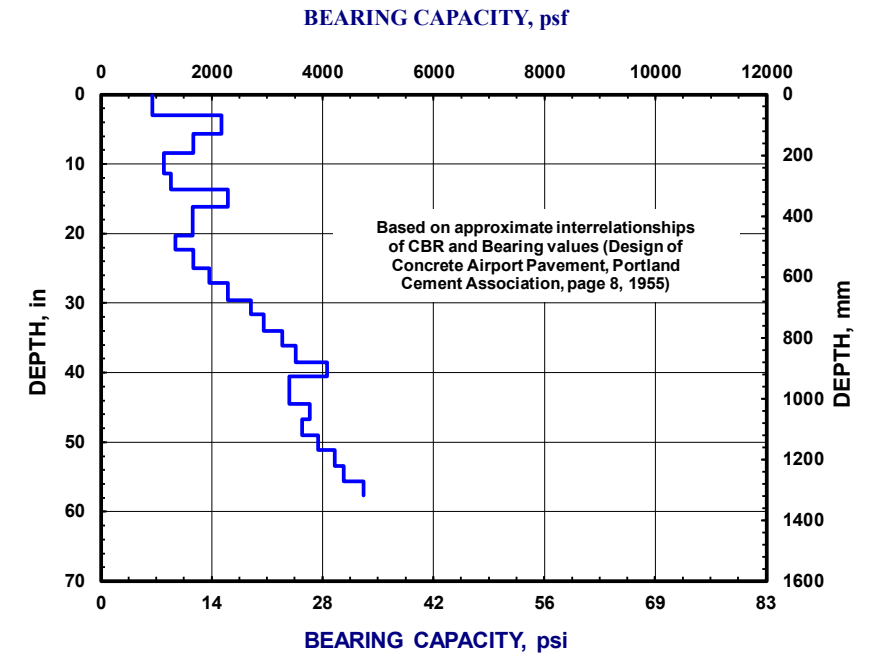
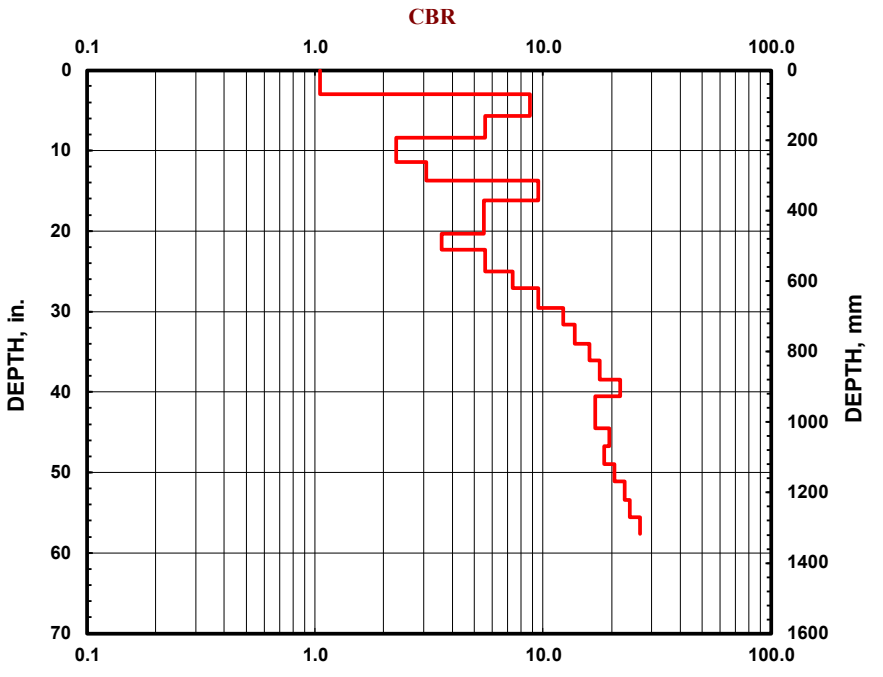
Dynamic Cone Penetrometer (In situ CBR) - ASTM D 6951

Project:	<u>Horry County Schools - Records Center</u>	Date:	<u>02/21/20</u>
Client:	<u>ECLS Global, Inc</u>	Soil Type(s):	<u>SM, CH</u>
Technician:	<u>M. Lumpkin</u>	Location:	<u>B-05</u>

Hammer	
<input type="radio"/> 10.1 lbs. - (2)	
<input checked="" type="radio"/> 17.6 lbs. - (1)	
<input type="radio"/> Both hammers used	

Soil Type	
<input type="radio"/> CH	
<input type="radio"/> CL	
<input checked="" type="radio"/> All other soils	

No. of Blows	Accumulative Penetration (mm)	Hammer Blow Factor
0	0	1
0.5	76	1
3	145	1
2	213	1
1	290	1
1	348	1
3	411	1
3	516	1
1	566	1
2	635	1
2	688	1
3	752	1
3	803	1
4	864	1
4	917	1
5	978	1
5	1029	1
4	1080	1
4	1130	1
5	1186	1
5	1245	1
5	1298	1
6	1356	1
6	1412	1
6	1463	1

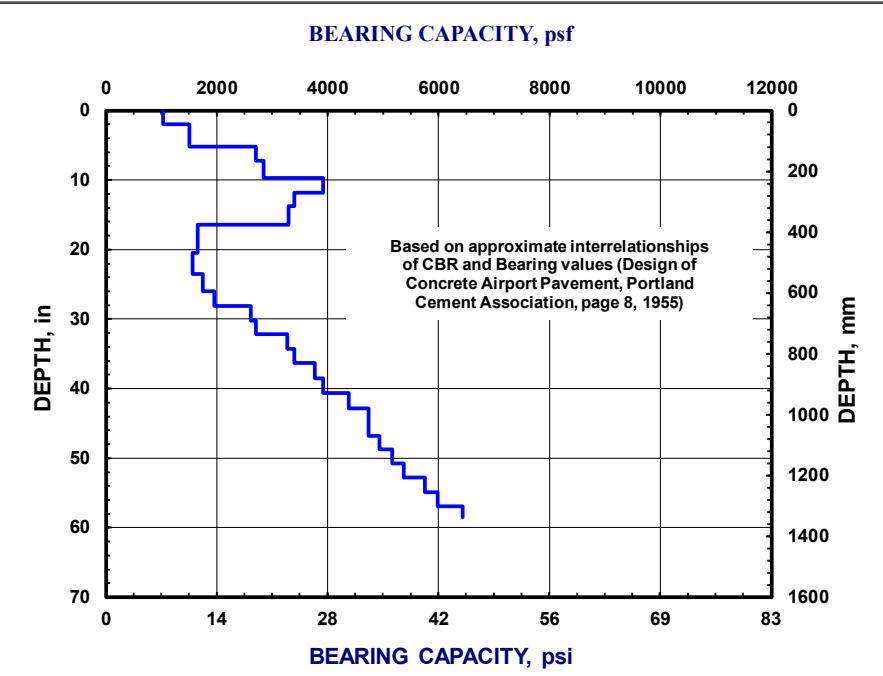
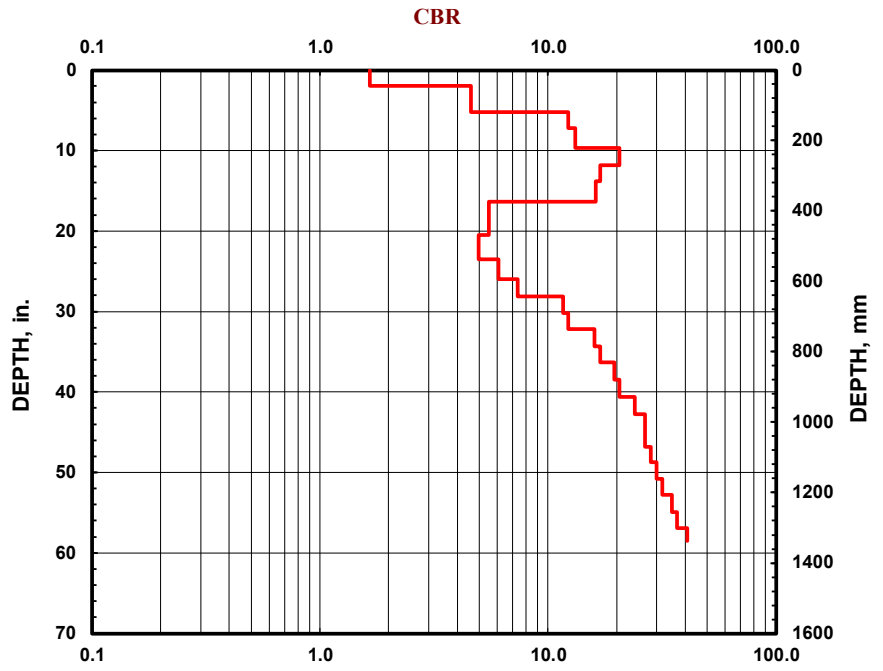


Dynamic Cone Penetrometer (In situ CBR) - ASTM D 6951

Project:	Horry County Schools - Records Center	Date: 02/21/20
Client:	ECLS Global, Inc	Soil Type(s): SM, CH
Technician:	M. Lumpkin	Location: B-06

Hammer <input type="radio"/> 10.1 lbs. - (2) <input checked="" type="radio"/> 17.6 lbs. - (1) <input type="radio"/> Both hammers used	Soil Type <input type="radio"/> CH <input type="radio"/> CL <input checked="" type="radio"/> All other soils
--	---

No. of Blows	Accumulative Penetration (mm)	Hammer Blow Factor
0	0	1
0.5	51	1
2	132	1
3	183	1
4	246	1
5	300	1
4	351	1
5	417	1
3	521	1
2	597	1
2	660	1
2	714	1
3	767	1
3	818	1
4	871	1
4	922	1
5	978	1
5	1031	1
6	1087	1
6	1138	1
6	1189	1
6	1237	1
7	1290	1
7	1341	1
8	1394	1
8	1445	1
7	1486	1





Geotechnical, Environmental, and Materials Engineers

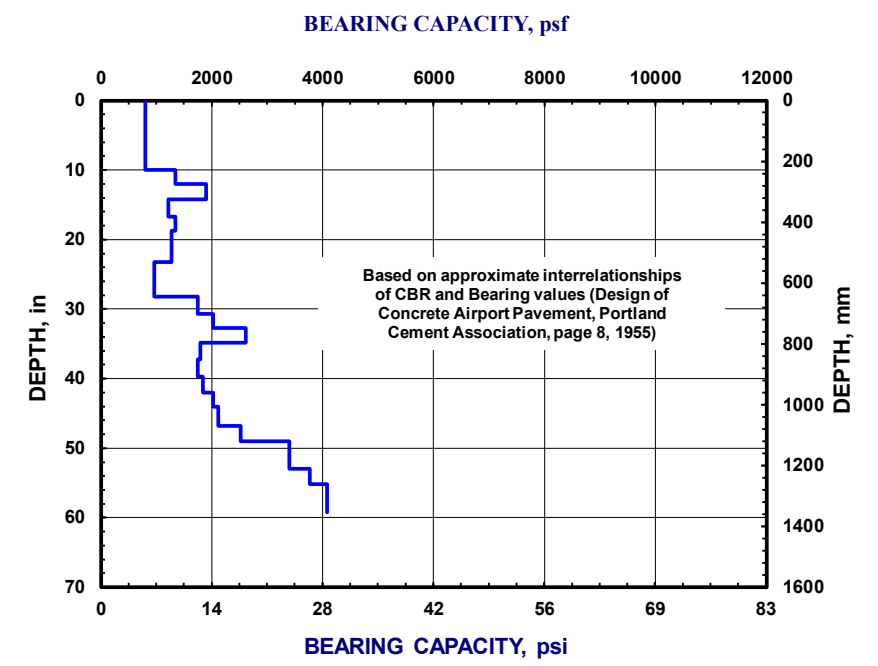
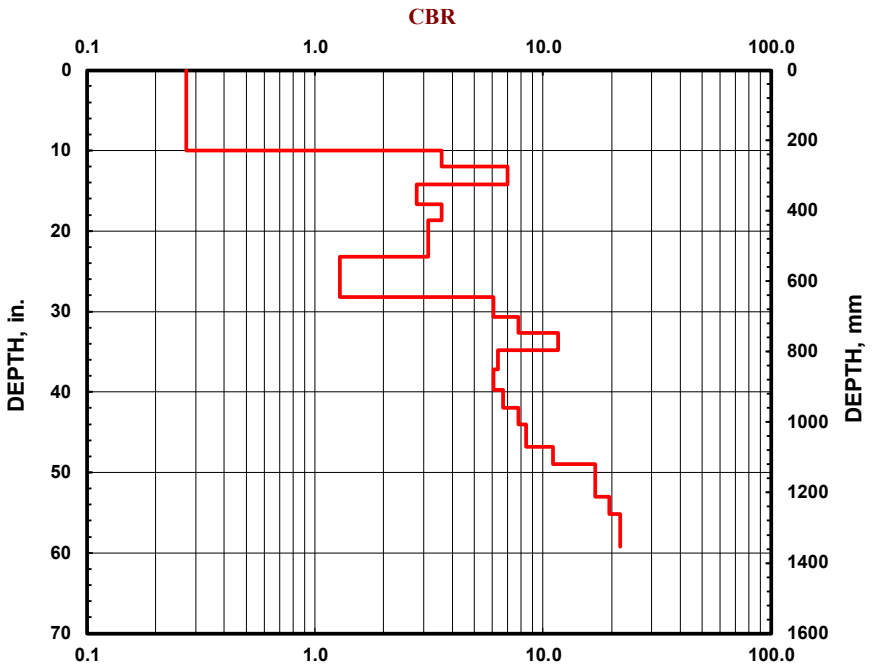
Dynamic Cone Penetrometer (In situ CBR) - ASTM D 6951

Project:	<u>Horry County Schools - Records Center</u>	Date:	<u>02/21/20</u>
Client:	<u>ECLS Global, Inc</u>	Soil Type(s):	<u>SC, SM, CH</u>
Technician:	<u>M. Lumpkin</u>	Location:	<u>B-07</u>

- Hammer**
- 10.1 lbs. - (2)
 - 17.6 lbs. - (1)
 - Both hammers used

- Soil Type**
- CH
 - CL
 - All other soils

No. of Blows	Accumulative Penetration (mm)	Hammer Blow Factor
0	0	1
0.5	254	1
1	305	1
2	361	1
1	424	1
1	475	1
2	589	1
1	716	1
2	780	1
2	831	1
3	884	1
2	945	1
2	1008	1
2	1067	1
2	1118	1
3	1189	1
3	1245	1
4	1295	1
4	1346	1
5	1402	1
5	1453	1
5	1504	1





Geotechnical, Environmental, and Materials Engineers

Dynamic Cone Penetrometer (In situ CBR) - ASTM D 6951

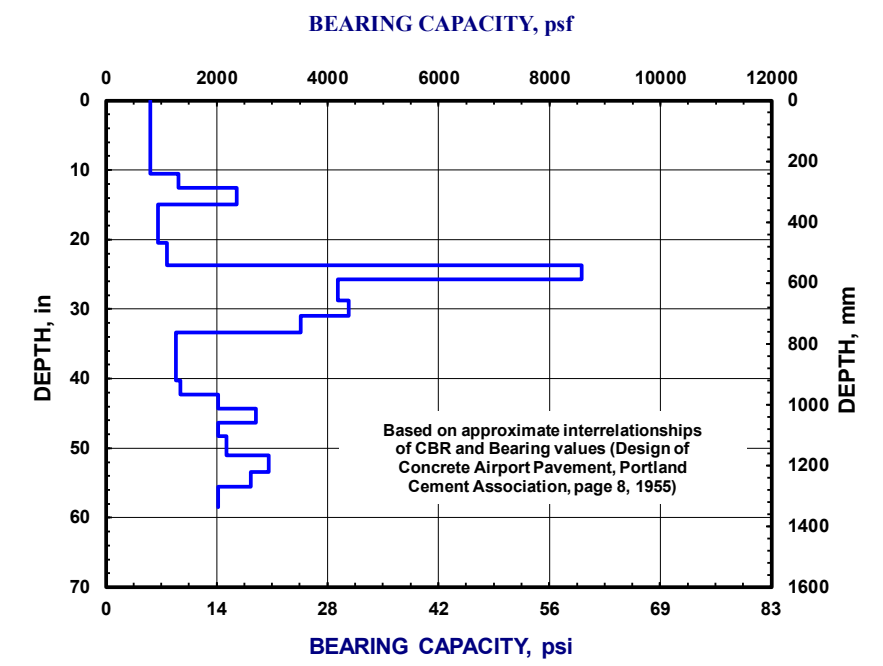
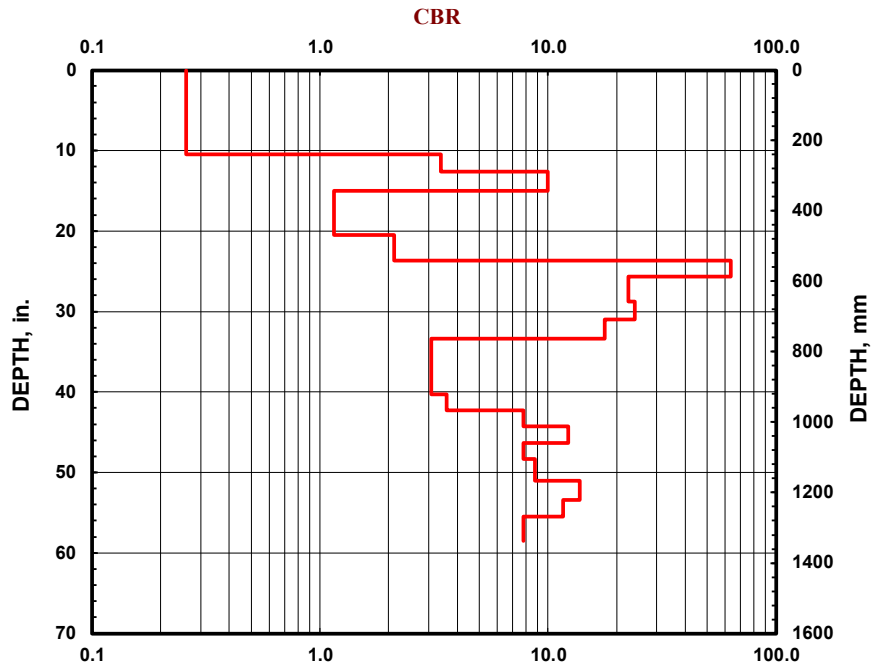
Project: Horry County Schools - Records Center
Client: ECLS Global, Inc
Technician: M. Lumpkin

Date: 02/21/20
Soil Type(s): SC, CH
Location: B-08

- Hammer**
- 10.1 lbs. - (2)
 - 17.6 lbs. - (1)
 - Both hammers used

- Soil Type**
- CH
 - CL
 - All other soils

No. of Blows	Accumulative Penetration (mm)	Hammer Blow Factor
0	0	1
0.5	267	1
1	320	1
3	381	1
1	521	1
1	602	1
13	653	1
8	732	1
6	787	1
5	848	1
3	1024	1
1	1074	1
2	1125	1
3	1176	1
2	1227	1
3	1295	1
4	1356	1
3	1410	1
3	1486	1





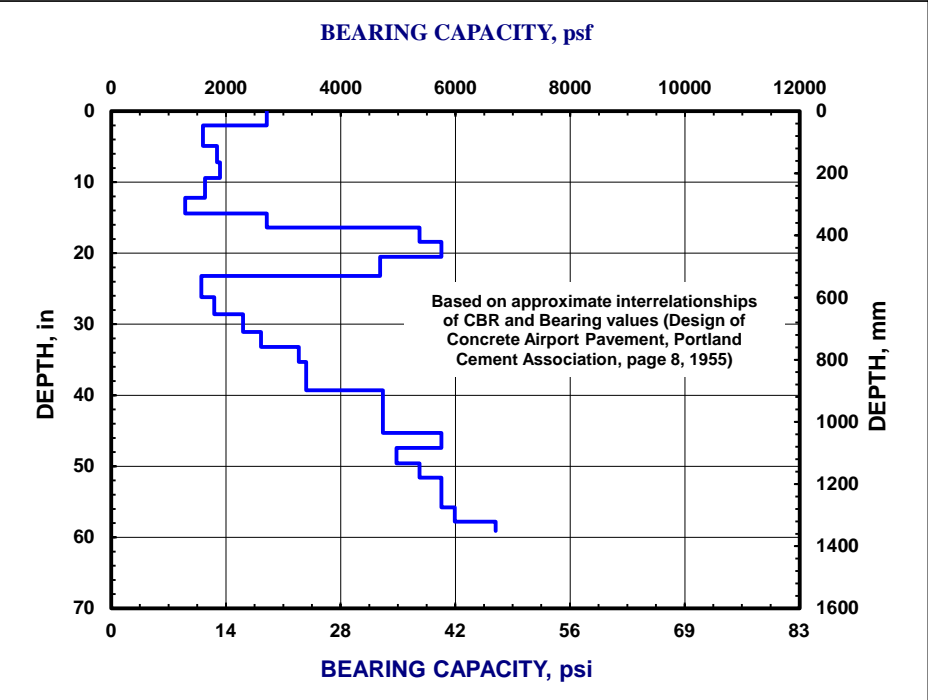
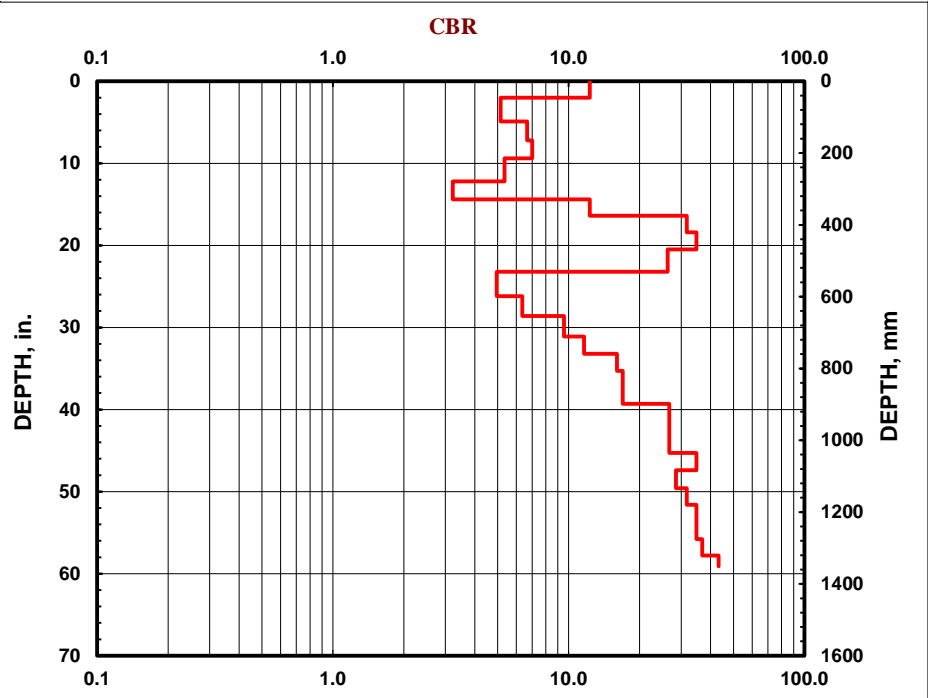
Dynamic Cone Penetrometer (In situ CBR) - ASTM D 6951

Project: Horry County Schools - Records Center **Date:** 02/21/20
Client: ECLS Global, Inc **Soil Type(s):** SC, CH
Technician: M. Lumpkin **Location:** B-09

Hammer
 10.1 lbs. - (2)
 17.6 lbs. - (1)
 Both hammers used

Soil Type
 CH
 CL
 All other soils

No. of Blows	Accumulative Penetration (mm)	Hammer Blow Factor
0	0	1
3	51	1
2	124	1
2	183	1
2	239	1
2	310	1
1	366	1
3	417	1
7	467	1
8	521	1
8	589	1
2	665	1
2	726	1
3	790	1
3	843	1
4	897	1
4	947	1
4	998	1
6	1049	1
6	1100	1
6	1151	1
8	1204	1
7	1260	1
7	1311	1
8	1364	1
8	1417	1
8	1468	1
6	1501	1





Geotechnical, Environmental, and Materials Engineers

Dynamic Cone Penetrometer (In situ CBR) - ASTM D 6951

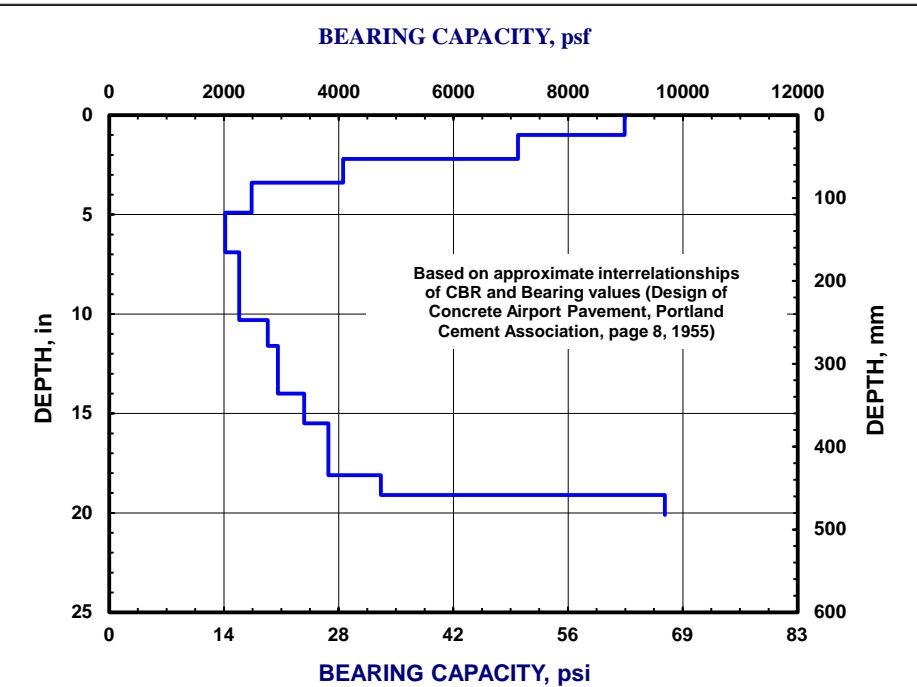
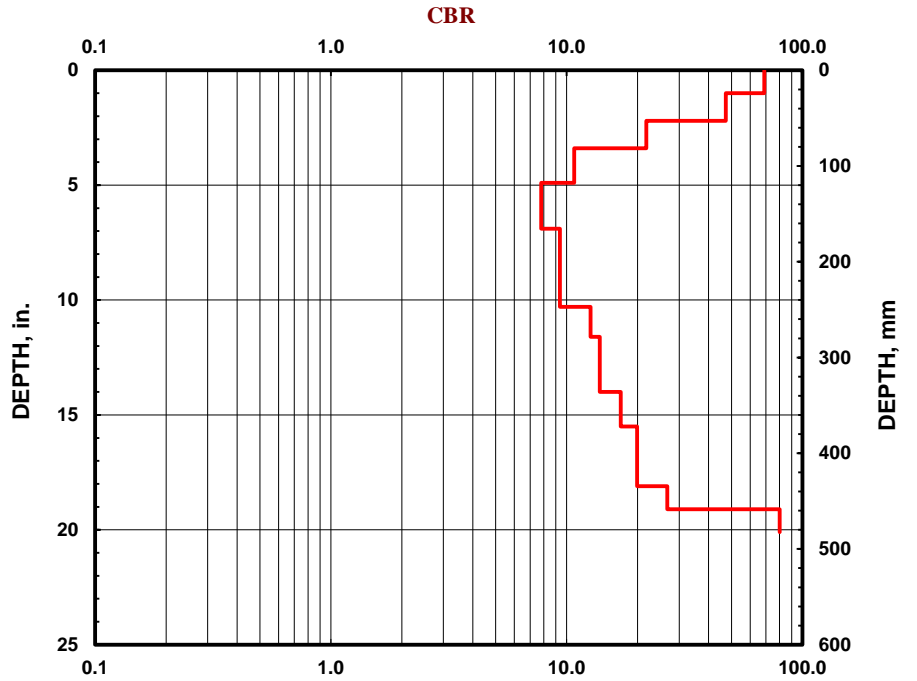
Project: Horry County Schools - Records Center
Client: ECLS Global, Inc
Technician: M. Lumpkin

Date: 02/21/20
Soil Type(s): SM
Location: B-10

- Hammer
 10.1 lbs. - (2)
 17.6 lbs. - (1)
 Both hammers used

- Soil Type
 CH
 CL
 All other soils

No. of Blows	Accumulative Penetration (mm)	Hammer Blow Factor
0	0	1
7	25	1
6	56	1
3	86	1
2	124	1
1	150	1
1	175	1
2	218	1
2	262	1
2	295	1
2	325	1
2	356	1
3	394	1
3	427	1
3	460	1
3	485	1
8	511	1



LABORATORY TEST PROCEDURES

A brief description of the laboratory tests performed is provided in the following sections.

DESCRIPTION OF SOILS (VISUAL-MANUAL PROCEDURE) (ASTM D2488)

The soil samples were visually examined by our engineer and soil descriptions were provided. Representative samples were then selected and tested in accordance with the aforementioned laboratory-testing program to determine soil classifications and engineering properties. This data was used to correlate our visual descriptions with the Unified Soil Classification System (USCS).

NATURAL MOISTURE CONTENT (ASTM D2216)

Natural moisture contents (M%) were determined on selected samples. The natural moisture content is the ratio, expressed as a percentage, of the weight of water in a given amount of soil to the weight of solid particles.

ATTERBERG LIMITS (ASTM D4318)

The Atterberg Limits test was performed to evaluate the soil's plasticity characteristics. The soil Plasticity Index (PI) is representative of this characteristic and is bracketed by the Liquid Limit (LL) and the Plastic Limit (PL). The Liquid Limit is the moisture content at which the soil will flow as a heavy viscous fluid. The Plastic Limit is the moisture content at which the soil is between "plastic" and the semi-solid stage. The Plasticity Index ($PI = LL - PL$) is a frequently used indicator for a soil's potential for volume change. Typically, a soil's potential for volume change increases with higher plasticity indices.

MATERIAL FINER THAN NO. 200 SIEVE BY WASHING (ASTM D1140)

Grain-size tests were performed to determine the partial soil particle size distribution. The amount of material finer than the openings on the No. 200 sieve (0.075 mm) was determined by washing soil over the No. 200 sieve. The results of wash #200 tests are presented on the boring logs included in this report and in the table of laboratory test results.

LABORATORY TEST RESULTS

The results of the laboratory testing are presented in the following tables.

BORING NO.	DEPTH	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	% PASSING #200 SIEVE	CLASSIFICATION
B-04	0.0 - 1.0	15.6					
B-04	1.0 - 2.0	17.2					
B-04	2.0 - 3.0	29.0	61	23	38	54	CH
B-04	3.0 - 4.0	28.1					
B-05	0.0 - 1.0	17.2					
B-05	1.0 - 2.0	19.6					
B-05	2.0 - 3.0	24.3	50	20	30	54	CH
B-05	3.0 - 4.0	24.8					
B-09	1.0 - 2.0	9.6					
B-09	2.0 - 3.0	18.0					
B-09	3.0 - 4.0	25.7	61	26	35	64	CH
B-09	4.0 - 5.0	23.7					

TABLE L-1: General Soil Classification Test Results

Soils with a Liquid Limit (LL) greater than 50 and Plasticity Index (PI) greater than 25 usually exhibit significant volume change with varying moisture content and are considered to be highly plastic

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you — should apply this report for any purpose or project except the one originally contemplated.*

Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an

assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by:* the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final*, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly

problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time to perform additional study.* Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help

others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Environmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold-prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical-engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you GBC-Member geotechnical engineer for more information.



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SECTION 013000
ADMINISTRATIVE REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Coordination and Project conditions.
- B. Preconstruction meeting.

1.2 CONDITIONS

- A. Coordinate scheduling, submittals, and Work of various Sections of Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Coordination Meetings: In addition to other meetings specified in this Section, hold coordination meetings with personnel and Subcontractors to ensure coordination of Work.
- C. Coordinate completion and clean-up of Work of separate Sections in preparation for Substantial Completion.
- D. After Owner's occupancy of premises, coordinate access to Site for correction of defective Work and Work not complying with Contract Documents, to minimize disruption of Owner's activities.

1.3 PRECONSTRUCTION MEETING

- A. Engineer will schedule and preside over meeting after Notice of Award.
- B. Attendance Required: Engineer, Owner, appropriate governmental agency representatives, major Subcontractors and Contractor.
- C. Minimum Agenda:
 - 1. Reviewing procedures for the safety of the students and staff while working on HCS property
 - 2. Communication procedures.
 - 3. Procedures and processing of requests for interpretations, field decisions, field orders, submittals, substitutions, Applications for Payments, proposal request, Change Orders, and Contract closeout procedures.
 - 4. Scheduling.
 - 5. Critical Work sequencing.

HORRY COUNTY SCHOOLS
HCS TRANSPORTATION TRAINING PAD
CONWAY, SOUTH CAROLINA

DN ENGINEERING, INC.
PROJECT NO. 2122-26MJ 07/21/2021

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION

SECTION 013300 SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Definitions.
- B. Submittal procedures.
- C. Construction progress schedules.
- D. Proposed product list.
- E. Product data.
- F. Use of electronic CAD files of Project Drawings.
- G. Shop Drawings.
- H. Samples.
- I. Other submittals.
- J. Design data.
- K. Test reports.
- L. Certificates.
- M. Manufacturer's instructions.
- N. Manufacturer's field reports.
- O. Erection Drawings.
- P. Construction photographs.
- Q. Contractor review.
- R. Engineer review.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action.

- B. Informational Submittals: Written and graphic information and physical Samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements.

1.3 SUBMITTAL PROCEDURES

- A. Transmit each submittal with CSI Form 12.1A - Submittal Transmittal
- B. Sequentially number transmittal forms. Mark revised submittals with original number and sequential alphabetic suffix.
- C. Identify: Project, Contractor, Subcontractor and supplier, pertinent Drawing and detail number, and Specification Section number appropriate to submittal.
- D. Apply Contractor's stamp, signed or initialed, certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is according to requirements of the Work and Contract Documents.
- E. Schedule submittals to expedite Project and submit electronic submittals via email as PDF electronic files. Coordinate submission of related items.
- F. For each submittal for review, allow 15 days excluding delivery time to and from Contractor.
- G. Identify variations in Contract Documents and product or system limitations that may be detrimental to successful performance of completed Work.
- H. Allow space on submittals for Contractor and Engineer review stamps.
- I. When revised for resubmission, identify changes made since previous submission.
- J. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.
- K. Submittals not requested will not be recognized nor processed.
- L. Incomplete Submittals: Engineer will not review. Complete submittals for each item are required. Delays resulting from incomplete submittals are not the responsibility of Architect/Engineer.

1.4 PROPOSED PRODUCT LIST

- A. Within 15 days after date of Notice to Proceed, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
- B. For products specified only by reference standards, indicate manufacturer, trade name, model or catalog designation, and reference standards.

1.5 PRODUCT DATA

- A. Product Data: Action Submittal: Submit to Architect/Engineer for review for assessing conformance with information given and design concept expressed in Contract Documents.

- B. Submit electronic submittals via email as PDF electronic files.
- C. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- D. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

1.6 ELECTRONIC CAD FILES OF PROJECT DRAWINGS

- A. Electronic CAD Files of Project Drawings: May only be used to expedite production of Shop Drawings for the Project. Allowed uses include grading software and record drawings.
- B. Electronic CAD Files of Project Drawings: Distributed only under the following conditions:
 - 1. Use of files is solely at receiver's risk. Engineer does not warrant accuracy of files. Receiving files in electronic form does not relieve receiver of responsibilities for measurements, dimensions, and quantities set forth in Contract Documents. In the event of ambiguity, discrepancy, or conflict between information on electronic media and that in Contract Documents, notify Engineer of discrepancy and use information in hard-copy Drawings and Specifications.
 - 2. CAD files do not necessarily represent the latest Contract Documents, existing conditions, and as-built conditions. Receiver is responsible for determining and complying with these conditions and for incorporating addenda and modifications.
 - 3. User is responsible for removing information not normally provided on Shop Drawings and removing references to Contract Documents. Shop Drawings submitted with information associated with other trades or with references to Contract Documents will not be reviewed and will be immediately returned.
 - 4. Receiver shall not hold Engineer responsible for data or file clean-up required to make files usable, nor for error or malfunction in translation, interpretation, or use of this electronic information.
 - 5. Receiver shall understand that even though Engineer has computer virus scanning software to detect presence of computer viruses, there is no guarantee that computer viruses are not present in files or in electronic media.
 - 6. Receiver shall not hold Engineer responsible for such viruses or their consequences, and shall hold Engineer harmless against costs, losses, or damage caused by presence of computer virus in files or media.

1.7 SHOP DRAWINGS

- A. Shop Drawings: Action Submittal: Submit to Engineer for assessing conformance with information given and design concept expressed in Contract Documents.
- B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. When required by individual Specification Sections, provide Shop Drawings signed and sealed by a professional Engineer responsible for designing components shown on Shop Drawings.
 - 1. Include signed and sealed calculations to support design.

2. Submit Shop Drawings and calculations in form suitable for submission to and approval by authorities having jurisdiction.
 3. Make revisions and provide additional information when required by authorities having jurisdiction.
- D. Submit electronic submittals via email as PDF electronic files.

1.8 SAMPLES

- A. Samples: Action Submittal: Submit to Engineer for assessing conformance with information given and design concept expressed in Contract Documents.
- B. Samples for Selection as Specified in Product Sections:
1. Submit to Engineer for aesthetic, color, and finish selection.
 2. Submit Samples of finishes, textures, and patterns for Engineer selection.
- C. Submit Samples to illustrate functional and aesthetic characteristics of products, with integral parts and attachment devices. Coordinate Sample submittals for interfacing work.
- D. Include identification on each Sample, with full Project information.
- E. Submit number of Samples specified in individual Specification Sections; Engineer will retain one Sample.
- F. Reviewed Samples that may be used in the Work are indicated in individual Specification Sections.
- G. Samples will not be used for testing purposes unless specifically stated in Specification Section.

1.9 OTHER SUBMITTALS

- A. Informational Submittal: Submit data for Engineer's knowledge as Contract administrator or for Owner.
- B. Submit information for assessing conformance with information given and design concept expressed in Contract Documents.

1.10 TEST REPORTS

- A. Informational Submittal: Submit reports for Engineer's knowledge as Contract administrator or for Owner.
- B. Submit test reports for information for assessing conformance with information given and design concept expressed in Contract Documents.

1.11 CERTIFICATES

- A. Informational Submittal: Submit certification by manufacturer, installation/application Subcontractor, or Contractor to Engineer, in quantities specified for Product Data.

- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or product but must be acceptable to Engineer.

1.12 MANUFACTURER'S INSTRUCTIONS

- A. Informational Submittal: Submit manufacturer's installation instructions for Engineer's knowledge as Contract administrator or for Owner.
- B. Submit printed instructions for delivery, storage, assembly, installation, startup, adjusting, and finishing, to Engineer in quantities specified for Product Data.
- C. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

1.13 MANUFACTURER'S FIELD REPORTS

- A. Informational Submittal: Submit reports for Engineer's knowledge as Contract administrator or for Owner.
- B. Submit report within 3 days of observation to Engineer for information.
- C. Submit reports for information for assessing conformance with information given and design concept expressed in Contract Documents.

1.14 ERECTION DRAWINGS

- A. Informational Submittal: Submit Drawings for Engineer's knowledge as Contract administrator or for Owner.
- B. Submit Drawings for information assessing conformance with information given and design concept expressed in Contract Documents.
- C. Data indicating inappropriate or unacceptable Work may be subject to action by Engineer or Owner.

1.15 CONTRACTOR REVIEW

- A. Review for compliance with Contract Documents and approve submittals before transmitting to Engineer.
- B. Contractor: Responsible for:
 - 1. Determination and verification of materials including manufacturer's catalog numbers.
 - 2. Determination and verification of field measurements and field construction criteria.
 - 3. Checking and coordinating information in submittal with requirements of Work and of Contract Documents.

4. Determination of accuracy and completeness of dimensions and quantities.
 5. Confirmation and coordination of dimensions and field conditions at Site.
 6. Construction means, techniques, sequences, and procedures.
 7. Safety precautions.
 8. Coordination and performance of Work of all trades.
- C. Stamp, sign or initial, and date each submittal to certify compliance with requirements of Contract Documents.
- D. Do not fabricate products or begin Work for which submittals are required until approved submittals have been received from Engineer.

1.16 ENGINEER REVIEW

- A. Do not make "mass submittals" to Engineer. "Mass submittals" are defined as six or more submittals or items in one day or 15 or more submittals or items in one week. If "mass submittals" are received, Engineer's review time stated above will be extended as necessary to perform proper review. Engineer will review "mass submittals" based on priority determined by Engineer after consultation with Owner and Contractor.
- B. Informational submittals and other similar data are for Engineer's information, do not require Engineer's responsive action, and will not be reviewed or returned with comment.
- C. Submittals made by Contractor that are not required by Contract Documents may be returned without action.
- D. Submittal approval does not authorize changes to Contract requirements unless accompanied by Change Order, Field Order, or Work Change Directive.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION 013300

SECTION 014000 QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Quality control.
- B. Tolerances.
- C. References.
- D. Labeling.
- E. Mockup requirements.
- F. Testing and inspection services.
- G. Manufacturers' field services.

1.2 QUALITY CONTROL

- A. Monitor quality control over suppliers, manufacturers, products, services, Site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with specified standards as the minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- C. Perform Work using persons qualified to produce required and specified quality.
- D. Products, materials, and equipment may be subject to inspection by Engineer and Owner at place of manufacture or fabrication. Such inspections shall not relieve Contractor of complying with requirements of Contract Documents.
- E. Supervise performance of Work in such manner and by such means to ensure that Work, whether completed or in progress, will not be subjected to harmful, dangerous, damaging, or otherwise deleterious exposure during construction period.

1.3 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

- B. Comply with manufacturers' recommended tolerances and tolerance requirements in reference standards. When such tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

1.4 REFERENCES

- A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current as of date of Contract Documents except where specific date is established by code.
- C. Obtain copies of standards and maintain on Site when required by product Specification Sections.
- D. When requirements of indicated reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.
- E. Neither contractual relationships, duties, or responsibilities of parties in Contract nor those of Engineer shall be altered from Contract Documents by mention or inference in reference documents.

1.5 LABELING

- A. Attach label from agency approved by authorities having jurisdiction for products, assemblies, and systems required to be labeled by applicable code.
- B. Label Information: Include manufacturer's or fabricator's identification, approved agency identification, and the following information, as applicable, on each label:
 - 1. Model number.
 - 2. Serial number.
 - 3. Performance characteristics.
- C. Manufacturer's Nameplates, Trademarks, Logos, and Other Identifying Marks on Products: Not allowed on surfaces exposed to view in public areas, interior or exterior.

1.6 MOCK-UP REQUIREMENTS

- A. Tests will be performed under provisions identified in this Section and identified in individual product Specification Sections.
- B. Assemble and erect specified or indicated items with specified or indicated attachment and anchorage devices, flashings, seals, and finishes.

- C. Accepted mockups shall be comparison standard for remaining Work.
- D. Where mockup has been accepted by Engineer and is specified in product Specification Sections to be removed, remove mockup and clear area when directed to do so by Engineer.

1.7 TESTING AND INSPECTION SERVICES

- A. Owner will employ and pay for specified services of an independent firm to perform testing and inspection.
- B. Independent firm will perform tests, inspections, and other services specified in individual Specification Sections and as required by authorities having jurisdiction.
 - 1. Laboratory: Authorized to operate in State of South Carolina.
 - 2. Laboratory Staff: Maintain full-time Professional Engineer on staff to review services.
 - 3. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to National Bureau of Standards or accepted values of natural physical constants.
- C. Testing, inspections, and source quality control may occur on or off Project Site. Perform off-Site testing as required by Engineer or Owner.
- D. Reports shall be submitted by independent firm to Engineer, Contractor, and authorities having jurisdiction, indicating observations and results of tests and compliance or noncompliance with Contract Documents.
 - 1. Submit final report indicating correction of Work previously reported as noncompliant.
- E. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
 - 1. Notify Engineer and independent firm 24 hours before expected time for operations requiring services.
 - 2. Make arrangements with independent firm and pay for additional Samples and tests required for Contractor's use.
- F. Employment of testing agency or laboratory shall not relieve Contractor of obligation to perform Work according to requirements of Contract Documents.
- G. Retesting or re-inspection required because of nonconformance with specified or indicated requirements shall be performed by same independent firm on instructions from Engineer. Payment for retesting or re-inspection will be charged to Contractor by deducting testing charges from Contract Sum/Price.
- H. Agency Responsibilities:

1. Test Samples of mixes submitted by Contractor.
 2. Provide qualified personnel at Site. Cooperate with Engineer and Contractor in performance of services.
 3. Perform indicated sampling and testing of products according to specified standards.
 4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 5. Promptly notify Engineer and Contractor of observed irregularities or nonconformance of Work or products.
 6. Perform additional tests required by Engineer.
 7. Attend preconstruction meetings and progress meetings.
- I. Agency Reports: After each test, promptly submit two copies of report to Engineer, Contractor, and authorities having jurisdiction. When requested by Engineer, provide interpretation of test results. Include the following:
1. Date issued.
 2. Project title and number.
 3. Name of inspector.
 4. Date and time of sampling or inspection.
 5. Identification of product and Specification Section.
 6. Location in Project.
 7. Type of inspection or test.
 8. Date of test.
 9. Results of tests.
 10. Conformance with Contract Documents.
- J. Limits on Testing Authority:
1. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 2. Agency or laboratory may not approve or accept any portion of the Work.
 3. Agency or laboratory may not assume duties of Contractor.
 4. Agency or laboratory has no authority to stop the Work.

1.8 MANUFACTURER'S FIELD SERVICES

- A. When specified in individual Specification Sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe Site conditions, conditions of surfaces and installation, quality of workmanship, startup of equipment, testing, adjusting and balancing as applicable, and to initiate instructions when necessary.
- B. Submit qualifications of observer to Engineer 30 days in advance of required observations. Observer is subject to approval of Engineer.
- C. Report observations and Site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturer's written instructions.

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CONWAY, SOUTH CAROLINA

DN ENGINEERING, INC.

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D. Refer to Section 013300 - Submittal Procedures, "Manufacturer's Field Reports" Article.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION 014000

SECTION 01 60 00 PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Products.
- B. Product delivery requirements.
- C. Product storage and handling requirements.
- D. Product options.
- E. Equipment electrical characteristics and components.

1.2 PRODUCTS

- A. At minimum, comply with specified requirements and reference standards.
- B. Specified products define standard of quality, type, function, dimension, appearance, and performance required.
- C. Furnish products of qualified manufacturers that are suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise. Confirm that manufacturer's production capacity can provide sufficient product, on time, to meet Project requirements.
- D. Domestic Products: Except where specified otherwise, domestic products are required and interpreted to mean products mined, manufactured, fabricated, or produced in United States or its territories.
- E. Do not use materials and equipment removed from existing premises except as specifically permitted by Contract Documents.
- F. Furnish interchangeable components from same manufacturer for components being replaced.

1.3 PRODUCT DELIVERY REQUIREMENTS

- A. Transport and handle products according to manufacturer's instructions.
- B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.
- C. Provide equipment and personnel to handle products; use methods to prevent soiling, disfigurement, or damage.

1.4 PRODUCT STORAGE AND HANDLING REQUIREMENTS

- A. Store and protect products according to manufacturer's instructions.
- B. Store products with seals and labels intact and legible.
- C. Store sensitive products in weathertight, climate-controlled enclosures in an environment suitable to product.
- D. For exterior storage of fabricated products, place products on sloped supports aboveground.
- E. Provide bonded off-Site storage and protection when Site does not permit on-Site storage or protection.
- F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- G. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.
- H. Provide equipment and personnel to store products; use methods to prevent soiling, disfigurement, or damage.
- I. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.5 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Products complying with specified reference standards or description.
- B. Products Specified by Naming One or More Manufacturers: Products of one of manufacturers named and complying with Specifications; no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit Request for Substitution for any manufacturer not named, according to Section 012500 - Substitution Procedures.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION

DIVISION 2
SITE WORK

SECTION 2000 – SITE CLEARING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Removal of surface debris.
- B. Clear site of plant life and grass.

1.02 REGULATORY REQUIREMENTS

- A. Conform to applicable code for disposal of debris.
- B. Coordinate clearing work with utility companies.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.01 PREPARATION

- A. Contractor shall clear and grub all areas necessary to allow implementation of the infrastructure.
- B. Clear all subsurface roots, plant life and debris a minimum of 1 foot deep.

3.02 PROTECTION

- A. Protect utilities that remain from damage.
- B. Protect bench marks and existing structures from damage or displacement.

3.03 REMOVAL

- A. Remove debris, rock and extracted plant life from site.

END OF SECTION

SECTION 2100 – EXCAVATION

PART I GENERAL

1.01 SECTION INCLUDES

- A. Grading and excavation for roadway and drives.
- B. Grading and excavation for pipelines and channels.
- C. All excavation, formation of embankments and finishing and dressing of graded earth areas, shoulders and ditches.

1.02 RELATED SECTIONS

- A. Section 1400 - Quality Control Testing
- B. Section 2200 – Backfilling

1.03 FIELD MEASUREMENT

- A. Verify that shot survey bench mark and intended elevations for the work are as indicated.

PART II PRODUCTS

Not Used

PART III EXECUTION

3.01 GENERAL

- A. The term "excavation" used hereinafter is defined as "unclassified excavation". Excavation of every description regardless of material encountered within the grading limits of the project, shall be performed to the lines and grades indicated. Satisfactory excavated material shall be transported to and placed in the fill areas within the limits of the work. When directed by the Engineer, unsatisfactory material encountered within the limits of the work shall be excavated below the grade shown and replaced with satisfactory material as directed in order to obtain the required surface condition and density to sustain the subsequent work. Such material ordered as a replacement shall be paid for at the unit prices given in the stated allowance shown in the proposal. Unsatisfactory and surplus excavation material not required for fill shall be disposed of by the Contractor off of the Owner's property as part of the contract price. During construction, excavation and filling shall be performed in a manner and sequence that will provide drainage at all times. Except where otherwise shown on the plans or as directed, the unsatisfactory soils shall be removed to a depth required and filled with selected sands and sand clays from

borrow excavations that will provide a firm, unyielding subgrade at the specified density. See Section 2200 - Backfilling for additional details.

- B. All areas covered by the project, including excavated and filled sections and adjacent transition areas, shall be uniformly smooth-graded. The finished surface shall be reasonably smooth, compacted and free from irregular surface changes. The degree of finish shall be that ordinarily obtainable from either blade grader or scraper operations. The finished surface shall be not more than 0.10 foot above or below the established grade or approved cross section. Gutters and ditches shall be finished so as to permit adequate drainage.
- C. All vegetation, roots, brush, sod, broken pavements, rubbish and other unsatisfactory or surplus material stripped or removed from the limits of construction shall be hauled off the Owner's property and disposed of by the Contractor as part of the contract price. The material shall be dumped, spread and leveled to drain.
- D. The Contractor shall be responsible for control of erosion and sedimentation during the work. Silt fence and sediment tubes or other devices as required shall be installed to prevent off-site deposits of eroded materials. Similar devices shall be placed around storm drain catch basins and inlets to prevent the infiltration of soil materials into the underground drainage system. Such devices shall be maintained until all site work is complete.

3.02 CONSERVATION OF TOPSOIL

- A. Areas designated for grading operations that contain a blanket of soil which is more satisfactory for the growth of grass than the embankment material to be placed, as determined by the Engineer, shall be stripped to a depth of approximately four to six inches and placed in convenient stockpiles as directed in the field, for later use as a topsoil blanket on the new graded areas specified herein, or as designated.
- B. Material ordered stockpiled shall be placed in satisfactory manner to afford drainage.
- C. When grading operations permit, instead of stockpiling, the topsoil shall be hauled and spread directly on the areas to receive topsoil.
- D. Surplus topsoil shall remain the property of the Owner.
- E. This work shall be the responsibility of the Contractor and considered subsidiary to the contract work.

3.03 PROTECTION OF EXISTING SERVICE LINES, UTILITIES AND STRUCTURES

- A. Existing utility lines and structures that are shown on the drawings or the locations of other utility lines which may exist in the project area, as well as utility lines constructed during excavation operations, shall be protected from damage during excavation, and if damaged, shall be repaired by the Contractor at his expense.
- B. When utility lines that are to be removed or relocated are encountered within the area of operations, the Contractor shall notify the utility company in ample time for the necessary measures to be taken to prevent interruption of the service.
- C. It shall be the Contractor's responsibility to contact all utility companies with services in the area for an accurate location of the respective utilities prior to beginning excavation.

3.04 EXCAVATION OF DITCHES

- A. Ditches shall be cut accurately to the cross sections and grades indicated by the drawings.
- B. All roots, stumps and other foreign matter in the sides and bottom of ditches shall be cut one foot below the grades indicated.
- C. Any excessive ditch excavation due to the removal of roots, stumps, etc., or due to over-excavation shall be backfilled to grade either with satisfactory soils, thoroughly compacted, or with suitable stone or cobble to form an adequate ditch paving, as directed at no additional cost to the Owner.
- D. The Contractor shall maintain all ditches excavated under this specification free from detrimental quantities of leaves, sticks and other debris until final acceptance of the work.
- E. Satisfactory earth material excavated from ditches and channel changes shall be placed in fill areas as directed.
- F. All excess excavation and debris shall be disposed of off-site at the Contractor's expense unless otherwise approved in writing by the Engineer/Owner.
- G. No diking or berming of soils along the bank will be permitted.
- H. No excavated materials shall be deposited within the distance of three feet from the edge of any ditches.
- I. When storm drain pipe terminates in a new ditch, ditch pavement, if specified, shall be constructed immediately as called for on the plans.
- J. The Contractor shall be responsible for maintaining these newly constructed ditches and take immediate action to keep erosion of the ditch bottom and

slopes to a minimum during the life of the contract. No additional compensation will be given to the Contractor for the required maintenance.

3.05 PREPARATION

- A. Identify required lines, levels, contours and datum.
- B. Identify known underground, above ground and aerial utilities. Stake and flag locations.
- C. Protect above and below grade utilities which are to remain.
- D. Protect plant life, lawns and other features remaining as a portion of final landscaping.
- E. Protect bench marks, existing structures, fences, sidewalks, paving and curbs from excavation equipment and vehicular traffic.

3.06 EXCAVATION

- A. Underpin adjacent structures which may be damaged by excavation work, including utilities and pipe chases.
- B. Excavate subsoil required to accommodate building foundations, slabs-on-grade, paving and site structures.
- C. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- D. Hand trim excavation. Remove loose matter.
- E. Remove lumped subsoil, boulders and rock up to 1/3 cubic yard measured by volume.
- F. Notify Engineer/Owner of unexpected subsurface conditions and discontinue affected work in area until notified to resume work.
- G. Correct unauthorized excavation at no extra cost to Owner.
- H. Remove excess excavated material not being used from the site at no additional cost to the Owner.

3.07 FIELD QUALITY CONTROL

- A. Field inspection will be performed under provisions of Section 1400.
- B. Provide for visual inspection of bearing surfaces.

3.08 PROTECTION

- A. Protect excavations by methods required to prevent cave-in or loose soil from falling into excavation.

END OF SECTION

SECTION 2200 – BACKFILLING

PART I GENERAL

1.01 SECTION INCLUDES

- A. Building perimeter and site structure backfilling to subgrade elevations.
- B. Site filling and backfilling.
- C. Fill and compaction of trenches.
- D. Fill under slabs-on-grade and paving.
- E. Consolidation and compaction.
- F. Fill for over-excavation.

1.02 RELATED SECTIONS

- A. Section 1400 - Quality Control and Testing Services.
- B. Section 2100 - Excavation.

1.03 REFERENCES

- A. ANSI/ASTM C136 - Method for sieve analysis of fine and course aggregates.
- B. ANSI/ASTM D1556 - Test method for density of soil in place by the sand cone method.
- C. ANSI/ASTM D1557 - Test methods for moisture - density relations of soils and soil aggregate mixtures using 10 15 hammer and 18 inch drop.
- D. ANSI/ASTM D2922 - Test methods for density of soils in place by nuclear methods.

1.04 SUBMITTALS

- A. Submit under provisions of Section 1300.

PART II PRODUCTS

2.01 FILL MATERIALS

- A. Type A (Class 1) - Course Stone Crushed: Angular, washed natural stone: free of shale, clay, friable material, sand, debris; graded in accordance with ANSI/ASTM C136 within the following limits:

Sieve Size	Percent Passing
2 inches	100
1 inch	95
3/4 inch	95 to 100
5/8 inch	75 to 100
3/8 inch	55 to 85
No. 4	35 to 60
No. 16	15 to 35
No. 40	10 to 25
No. 200	5 to 10

- B. Type B (Class 2) - Pea Gravel: Natural stone; washed, free of clay, shale, organic matter; graded in accordance with ANSI/ASTM, to the following:

1. Minimum Size: 1/4 inch
2. Maximum Size: 5/8 inch

- C. Type C (Class 3) - Sand: Natural river or bank sand; washed: Free of silt, clay, loam friable or soluble materials or organic matter; graded in accordance with ANSI/ASTM C136, within the following limits:

Sieve Size	Percent Passing
No. 4	100
No. 14	10 to 100
No. 50	5 to 90
No. 100	4 to 30
No. 200	0

- D. Subsoil: Reused and/or imported, free of gravel larger than 3 inch size, roots and other organic material and trash and approved by the Engineer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify from Engineer/Owner fill materials to be reused are acceptable.

3.02 PREPARATION

- A. Generally, compact subgrade to density requirements for subsequent backfill materials.
- B. Cut out soft areas of subgrade not capable of in situ compaction. Backfill with Type C fill and compact to density equal to or greater than

requirements for subsequent backfill material.

- C. Prior to placement of aggregate base course material at gravel or paved areas, compact subsoil 98 percent of its maximum dry density in accordance with ANSI/ASTM D1557 and AASHTO T-180.
- D. All vegetation, such as roots, brush, heavy sods, heavy growth of grass and all decayed vegetable matter, rubbish and other unsuitable material within the area upon which fill is to be placed shall be stripped or otherwise removed before the fill is to be placed shall be stripped or otherwise removed before the fill is started.
- E. In no case will unstable material remain in or under the fill area that will prevent the placement and compaction of subsequent layers to the specified densities.
- F. Sloped ground surfaces steeper than one vertical to four horizontal on which fill is to be placed shall be plowed, stepped and benched, or broken up as directed, in such manner that the fill material will bond with the existing surface.
- G. Prepared surfaces on which compacted fill is to be placed shall be scarified, wetted or dried as may be required to obtain the compaction specified.

3.03 BACKFILLING

- A. Backfill areas at the locations and to lines and elevations shown on the plans.
- B. Filled areas shall conform to the shape of the typical sections indicated or shall meet the requirements of the particular case.
- C. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.
- D. Granular Sand Fill: Place and compact materials in continuous layers not exceeding 6 inches compacted depth.
- E. Soil Fill: Place and compact material in continuous layers not exceeding 8 inches compact depth.
- F. Employ a placement method that does not disturb or damage utilities in trenches.
- G. Maintain optimum moisture content of backfill materials to attain required compaction density.

- H. Slope grade away from buildings minimum 2 inches in 10 ft., unless noted otherwise.
- I. Make grade changes gradual. Blend slope into level areas.
- J. Remove surplus backfill materials from site.
- K. Leave fill material stockpile areas completely free of excess unsuitable materials.

3.04 TOLERANCES

- A. Top Surface of Backfilling: Plus or minus five hundredths from required elevations.

3.05 FIELD QUALITY CONTROL

- A. Field inspection will be performed by the Owner.
- B. Field testing will be performed under provisions of Section 1400.
- C. Tests and analysis of fill material will be performed in accordance with ANSI/ASTM D1557 (AASHTO - T-180) and ANSI/ASTM D2922 with Section 1400.
- D. Compaction testing will be performed in accordance with ANSI/ASTM D2922 and ANSI/ASTM D1557 (AASHTO-190).
- E. If tests indicate work does not meet specified requirements, remove work, replace and retest at no cost to owner.
- F. Frequency of tests: as required by the testing firm or as directed by the Engineer.
- G. Proof roll all compacted fill surfaces under paving.

3.06 PROTECTION OF FINISHED WORK

- A. Protect all finished Work.
- B. Recompact fills subjected to vehicular traffic.

3.07 COMPACTION REQUIREMENTS

- A. The compaction of fill materials shall meet the following requirements as determined by the maximum density obtained at optimum moisture content by an approved laboratory.
 - a. Fill under buildings100%
 - b. Fill under paved areas 98%

- c. Fill in other areas 95%
- B. The Contractor shall be responsible for compaction of the existing soils to meet the above compaction requirements.
- C. The Contractor will be responsible for compacting the sub-base to the required density by whatever means necessary.

3.08 SCHEDULE

- A. Fill under grassed areas.
 - 1. Subsoil fill, to finished grade
- B. Fill under asphaltic concrete pavement.
 - 1. Type C fill to 8 inches below finished paving elevation.

END OF SECTION

SECTION 2300 – TRENCHING

PART I GENERAL

1.01 SECTION INCLUDES

- A. Excavate trenches for utilities.
- B. Compacted bedding under fill over utilities.
- C. Backfilling and compaction.

1.02 RELATED SECTIONS

- A. Section 1400 - Quality Control and Testing Services
- B. Section 2100 - Excavation
- C. Section 2200 - Backfilling
- D. Section 2500 - Storm Drainage Systems

1.03 REFERENCES

- A. ANSI/ASTM C136 - Method for sieve analysis of fine and coarse aggregates.
- B. ANSI/ASTM D1556 - Test method for density of soil in place by the sand cone method.
- C. ANSI/ASTM D1557 - Test methods for moisture - density relations of soils and soil aggregate mixtures using 10 15 hammer and 18 inch drop.
- D. ANSI/ASTM D2922 - Test methods for density of soils in place by nuclear methods.

1.04 FIELD MEASUREMENTS

- A. Verify that survey benchmark and intended elevations for the Work are as shown on Drawings prior to proceeding with construction.

PART II PRODUCTS

2.01 FILL MATERIALS

- A. Type C and subsoil materials as specified in Section 2200.

2.02 BED MATERIALS

- A. Type 1 Material: As specified for Type A in Section 2200.

PART III EXECUTION

3.01 EXAMINATION

- A. Verify fill materials to be reused are acceptable.

3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Maintain and protect existing utilities remaining, which pass through work area.
- C. Protect plant life, lawns, rock outcropping and other features remaining as a portion of final landscaping.
- D. Protect bench marks, existing structures, fences, sidewalks, paving and curbs from excavation equipment and vehicular traffic.
- E. Protect above and below grade utilities which are to remain.
- F. Cut out soft areas of subgrade not capable of in situ compaction. Backfill with Type 3 fill and compact to density equal to or greater than requirements for subsequent backfill material.

3.03 EXCAVATION

- A. Excavate subsoil required for storm sewer.
- B. Cut trenches sufficiently wide to enable installation of utilities and allow inspection.
- C. Excavation shall not interfere with normal 45 degree bearing splay of foundations.
- D. Hand trim excavation. Remove loose matter.
- E. Remove lumped subsoil, boulders and rock.
- F. Correct unauthorized excavation at no cost to Owner.
- G. Correct areas over-excavated by error in accordance with Section 2200.
- H. Remove excess material not being used from site.

3.04 EXCAVATION PROTECTION

- A. Protect excavations by shoring, bracing sheet piling, underpinning, or other methods required to prevent cave-in or loose soil from falling into excavation.
- B. Notify Engineer of unexpected subsurface conditions and discontinue work in the affected area until notification to resume work is given.
- C. Protect bottom of excavation and soil adjacent to and beneath foundations from frost.
- D. Grade excavations top perimeter to prevent surface water run off into trench excavation.

3.05 BEDDING

- A. Support pipe during placement and compaction of bedding fill.

3.06 BACKFILLING (RECOMMENDED TECHNIQUE)

- A. Backfill trenches to elevations shown on plans.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.
- C. Granular Sand Fill: Place and compact material in continuous layers not exceeding 6 inches compacted depth.
- D. Soil Fill: Place and compact material in continuous layers not exceeding 8 inches compacted depth.
- E. Employ a placement method that does not disturb or damage foundation perimeter, pipe, conduit in trench.
- F. Maintain optimum moisture content of backfill materials to attain required compaction density.
- G. Remove surplus backfill materials from site.
- H. Leave fill material stockpile areas completely free of excess unsuitable materials.

3.07 TOLERANCES

- A. Top Surface of Backfilling: Plus or minus five hundredths from required elevations.

3.08 FIELD QUALITY CONTROL

- A. Field inspection will be performed by the Owner.
- B. Field testing will be performed under provisions of Section 1400.
- C. Tests and analysis of fill material will be performed in accordance with ANSI/ASTM D1557 and or ANSI/ASTM D2922.
- D. Compaction testing will be performed in accordance with ANSI/ASTM D2922 and ANSI/ASTM D1557.
- E. If tests indicate work does not meet specified requirements, remove work, replace and retest at no cost to owner.
- F. Frequency of tests: As required by the testing firm or as directed by the Engineer/Owner.

3.09 PROTECTION OF FINISHED WORK

- A. Protect all finished Work under provisions of Section 1500.
- B. Recompact fills subjected to vehicular traffic.

END OF SECTION

SECTION 2400 – HOT MIX ASPHALT PAVEMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aggregate Base and Hot Mix Asphalt Pavement.
- B. Sampling and Testing.

1.02 RELATED SECTIONS

- A. Section 2100 – Excavation
- B. Section 2200 – Backfilling
- C. Section 2580 – Pavement Markings
- D. Section 2401 – Specifications for Hot Mix Asphalt
- E. Section 2402 – Supplementary Bid Schedule Item Specifications

1.03 REFERENCES

- A. SCDOT SS - South Carolina State Highway Department Standard Specifications, 2007 Edition.
- B. Federal Highway Administration Manual on Uniform Traffic Control Devices.
- C. ASTM D 1188 - Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
- D. ASTM D 1556 - Density of Soil in Place by the Sand-Cone Method
- E. ASTM D 1557 - Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft)
- F. ASTM D 2726 - Bulk Specific Gravity of Compacted Surface-Dry Specimens
- G. ASTM D 2922 - Density of Soil and Soil-Aggregate in Place by Nuclear Methods
- H. ASTM D 3017 - Moisture Content of Soil and Rock in Place by Nuclear Methods

1.04 QUALITY ASSURANCE

A.Except as specified herein or as indicated, work and materials shall be in accordance with the SCDOT SS and SCDOT Supplemental Technical Specifications for Hot Mix Asphalt (HMA). The provisions therein for method of measurement and payment do not apply.

B.Obtain materials from same source throughout.

C.Coordinate with testing laboratory to provide testing as specified in Section 01400 - Testing Laboratory Services.

1.05 ENVIRONMENTAL REQUIREMENTS

A.Do not produce or place asphaltic concrete when the weather is rainy or foggy, when the base course is frozen or has excess moisture, or when the ambient temperature is less than 40 degrees F in the shade away from artificial heat.

1.06 SUBMITTALS

A.Job-Mix Formula: Submit the mix design, including mixing temperature, for approval. The mix design shall include a certified laboratory analysis of mix composition with void content and flow. After mix design approval, job mixes shall conform to the range of tolerances specified in SCDOT SS. Obtain acknowledgment of receipt prior to asphaltic concrete placement. Submit additional data regarding materials if the source of the materials changes.

1.07 BARRICADES AND SIGNALS

A.Provide and maintain temporary signs, signals, lighting devices, markings, barricades, and channelizing and hand signaling devices in accordance with the Manual on Uniform Traffic Control Devices to protect personnel and new construction from damage by equipment and vehicles until the surface is approved by the Engineer.

1.08 WARRANTY

A.Contractor shall provide an unconditional maintenance free warranty in writing for all asphaltic concrete paving against defects in workmanship and materials for a period of one (1) year. The warranty period shall begin on the date of the final approval. The warranty shall be executed by the paving subcontractor and cosigned by the General Contractor.

B.Condition at Expiration of Warranty Period: At his own expense and just before expiration of the one (1) year warranty period, the Contractor shall make such repairs as may be necessary to produce a pavement which shall:

1. Have a contour substantially conforming to that of the pavement

indicated on the drawings, and free from depressions of any kind exceeding 1/8" deep as measured between any points 4 feet apart on a line conforming substantially to the original contour of the paved area.

2. Be free from cracks or depressions showing disintegration of the surface mixture.
3. Contain no disintegrated surface mixture.
4. Not have been reduced more than 3/8" in thickness in any part.
5. Have a base free from cracks or defects which will cause its disintegration or settling of the pavement.

PART 2 PRODUCTS

2.01 MATERIALS

- A. HMA Intermediate Course: SCDOT SS, Section 402, Type C for material and mix.
- B. HMA Surface Course: SCDOT SS, Section 403, Type C for material and mix.
- C. Base Course: SCDOT SS, Section 305.
- D. Tack Coat: SCDOT SS, Section 401.2.1 Binder and Additives – Emulsified asphalt, Type SS-1

2.02 MIX PLANT

- A. SCDOT SS, Section 401, Type 1.

PART 3 EXECUTION

3.01 INSTALLATION AND APPLICATION

- A. Tack Coat:
 1. Apply to contact surfaces of previously constructed asphaltic concrete course and surfaces abutting or projecting into asphalt concrete pavement.
 2. Apply tack coat in accordance with SCDOT's Standard Specifications.
 3. Allow tack to "break" before placement of HMA.

3.02 PLACING HOT MIX ASPHALT CONCRETE PAVEMENT

- A. Placing Temperature – The mixture shall be delivered to the spreader at a temperature between 275 degrees and 325 degrees F and within 20 degrees F. of the temperatures set at the plant for the approved mix design. Mixtures which have a lower temperature shall be rejected.
- B. Joints - Where new pavement abuts existing pavement, cut existing surface course along straight lines approximately 6 inches from edge. Cuts shall be vertical and

extend full depth of surface course. Prior to HMA placement, apply asphalt cement to exposed edges of cold joints.

- C. Spreading and Finishing Equipment - Spread the HMA to a uniform density and produce a smooth finish, true to cross section and free from irregularities. Provide adjustable screeds to shape the surface to true cross section.
- D. HMA Placement - As continuous as possible. Place in maximum 2-inch lifts. Avoid passing rollers over unprotected edges of asphalt prior to asphalt cooling. If rollers pass over unprotected edges of asphalt prior to cooling, cut asphalt back to expose full depth of asphalt. Immediately prior to resumption of HMA placement, coat exposed edges of asphalt with asphalt cement. When HMA placement resumes, rake the hot asphalt against asphalt cement and compact.
- E. Feathered edges - Accomplish featheredging by raking out the larger aggregate as necessary and sloping the pavement uniformly throughout the featheredge to create a smooth transition. Unless indicated otherwise, featheredge transition shall be 10 feet.
- F. Compaction - SCDOT SS for equipment and compaction procedures, modified to compact asphalt to 96 percent of maximum laboratory density. Finished surfaces shall be uniform in texture and appearance and free of cracks and creases.
- G. Protection - No vehicular traffic shall be allowed on pavement for a minimum of 6 hours after final rolling, or until asphalt has cured, whichever is longer.

3.03 TOLERANCES OF PAVEMENT

- A. Flatness: Maximum variation of 1/4 inch measured with a 10 foot straight edge.
- B. Compacted Scheduled Thickness: Shall be no less than 90% of the minimum required depth.
- C. Any deficiencies in the pavement shall be removed and replaced in a curb and gutter section, or overlaid if no curbing is present. Paving “birdbaths” will not be allowed.

3.04 FIELD QUALITY CONTROL

- A. Sampling: Provide new materials where samples are taken. Take the number and size of samples required to perform the following tests.
 - 1. HMA Sampling
 - a. Job Mix: Take one initial sample and one sample for every 400 tons or fraction thereof.
 - b. Thickness: Take one sample for every 500 square yards or fraction thereof.
 - c. Density: One field test for every 1000 square yards or fraction thereof, and one laboratory test for the project. Provide minimum 6-inch diameter cores.

2. Base Course Sampling
 - a. Thickness: Take one sample for every 500 square yards or fraction thereof.
 - b. Density: One field test for every 1000 square yards or fraction thereof, and one laboratory test for the project.
- B. Testing: Provide for each sample.
1. HMA Testing
 - a. Job Mix: Determine gradation and bitumen content.
 - b. Thickness: Maximum allowable deficiency shall be 1/4 inch less than the indicated thickness.
 - c. Density, In Place: ASTM D 2922 and ASTM D 3017; cored sample ASTM D 1188 or ASTM D 2726.
 2. Base Course Testing
 - a. Thickness: Maximum allowable deficiency shall be 1/2 inch less than the indicated thickness.
 - b. Density: ASTM D 1556 or ASTM D 2922 and ASTM D 3017

END OF SECTION

SECTION 2405 – BASE COURSE MATERIAL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Stabilized Aggregate Base Coarse.
- B. Subgrade Preparation.

1.02 RELATED SECTIONS

- A. Section 2100 - Excavation.
- B. Section 2200 - Backfilling.

1.03 REFERENCES

- A. SCDOT Standard Specifications, Latest Edition.
- B. SCDOT Manual of Uniform Traffic Control Devices for Streets and Highways.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with the SCDOT Standards.
- B. Obtain materials from same source throughout.

1.05 TESTING REQUIREMENTS

- A. Testing and analysis of asphaltic mix will be performed under provisions of Section 1400 - Quality Control and Testing Services.
- B. Submit proposed mix design of each class of mix for review prior to commencement of work.
- C. Gradation of materials shall be in accordance with ASTM C136.

1.06 SUBMITTALS

- A. Certificates: Provide certificates stating that materials supplied comply with the specifications. Certificates shall be signed by asphalt producer and Contractor.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Place base course when air temperature is above 40 degrees F. and rising.

1.08 DEFINITIONS

- A. Pavement Structure: The combination of sub-base, base, pavement or other specified layer placed on the subgrade to support the traffic load and distribute it to the roadbed.
- B. Pavement: The uppermost layer of material placed on the base course consisting of one or more layers of asphaltic concrete. The binder, intermediate and surface wearing courses are considered part of the pavement. The term has the same intent and meaning as "surface" or "surfacing".

PART 2 PRODUCTS

2.01 STABILIZED AGGREGATE BASE COARSE MATERIALS

- A. Base coarse shall be composed of coarse aggregate together with fine aggregate or binder material and water, which shall be mixed, compacted and primed.
- B. Material must come from a SCDOT approved pit unless otherwise specified on the plans or by the Engineer/Owner.
- C. Stabilized aggregate base shall meet the composite mixture gradation:

Sieve Designation	Percentage by Weight Passing
1 1/2"	100
1"	--
3/4"	65 - 100
1/2"	50 - 90
3/8"	45 - 70
No. 4	35 - 55
No. 30	17 - 38
No. 200 (liquid amount - 25 max.) (plasticity index - 6 max.)	6 - 15

The amount passing the number 200 shall be determined by the wash method.

- D. Meet all requirements in the SCDOT standard specifications for highway construction, Section 305(2007Edition).

2.02 SUBGRADE PREPARATION

- A. Work shall consist of the removal of existing base courses and the construction and preparation of the subgrade on that part of the roadway intended to receive the pavement, sidewalks, curb, curb and gutter, base course, and shoulders.

- B. After all earthwork has been substantially completed and all drains and structures have been completed and backfilled, the subgrade, when compared to the satisfaction of the Engineer/Owner, shall conform to the lines and grades shown on the plans or as established by the Engineer/Owner.

2.03 COQUINA BASE COURSE

- A. Coquina base shall be from an approved SCDOT pit, unless otherwise specified on the plans or by the Engineer/Owner.
- B. Coquina base course shall meet the following composite mixture gradation:

Passing 3 ½" sieve, % by weight	100	-
Passing No. 200 sieve, % by weight	5	30
Liquid limit	---	30
Plasticity Index	---	6

*Amount passing the No. 200 sieve shall be determined by the wash method.

- C. Coquina shell base shall be composed of a mixture of aggregated shells, shell fragments and varying amounts of sand and clay obtained from naturally existing deposits.

PART III EXECUTION

3.01 INSPECTION

- A. Verify compacted subgrade is dry and ready to support a compacted base course.
- B. Verify compacted base course is dry and ready to support paving and imposed loads.
- C. Verify gradients and elevations of subgrade and base course respectively are correct before next stage of construction begins.
- D. Beginning of installation means acceptance of substrate.

3.02 SUBGRADE PREPARATION

- A. Remove existing base course; shape and compact subgrade.
- B. Prior to beginning paving work, inspect subgrade for loose or soft material, rock or organic matter. No stones over 2" in diameter will be allowed in to 6" of subgrade.

- C. Proof roll cut subgrade using loaded 20 ton dump truck or similar weight construction equipment to verify that subgrades are stable and to identify loose or soft areas requiring undercutting or stabilization.
- D. Stabilization of soft or unstable subgrades shall be accomplished to minimum depth of 8". Stabilizing aggregate shall be of type specified for base course aggregate unless otherwise shown on the plans or stated by the Engineer.
- E. Verify elevations and cross sections of subgrade immediately prior to placing base course material.

3.03 BASE COURSE PREPARATION

- A. The base course shall be placed on the approved subgrade and uniformly spread.
- B. Shape base to provide thicknesses and widths shown on the plans.
- C. Care shall be taken to prevent segregation of the fine from the coarse aggregates during the handling, spreading or shaping of the materials. All areas of segregation shall be corrected.
- D. The base shall be consolidated by rolling until the base is thoroughly bonded and compacted to a minimum density of 100%.
- E. Apply primer over substrate at uniform rate of 1/3 gal/sq. yard.
- F. Apply primer in accordance with SCDOT's Standard Specifications.
- G. Use clean sand to blot excess primer.
- H. Apply primer to contact surfaces of curbs and gutters.
- I. Coat surfaces of manhole and catch basin frames with oil to prevent bond with asphalt paving.

3.04 TOLERANCES

- A. Compaction and Density Requirements:
 - 1. Base and sub-base: Compact to 100% and 98% respectively.
- B. Allowable Variation in Thickness:
 - 1. Base course: (+/-) 1/2".

- C. Surface Smoothness: Test finished surface of each course for smoothness using a 10' straight edge. Intervals of tests shall be as directed by the Engineer. Surfaces will not be acceptable if exceeding the following:
 - 1. Base course: 1/2" in 10'-0".
 - 2. Surface (wearing) course: 1/4" in 10' - 0".
- D. Laboratory shall test in place courses for compliance with specified density, thickness and surface smoothness.
- E. Contractor's duties relative to testing shall include:
 - 1. Coordinating with Engineer/Owner and laboratory for field testing.
 - 2. Paying costs for retesting where initial tests reveal non conformance with specified requirements.

3.05 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 1400.

3.06 TRAFFIC CONTROL

- A. Comply with State Manual of Uniform Traffic Devices for Streets and Highways.
- B. Maintain vehicular and pedestrian traffic during placement operations as required for other construction activities. Flagmen may be required.
- C. Provide flagmen, barricades, warning signs and warning lights for movement of traffic and safety and to cause the least interruption of work.

3.07 CLEANING AND PROTECTION

- A. At completion of each operation, remove excess or spilled materials from site.

END OF SECTION

SECTION 2500 – STORM DRAINAGE SYSTEMS

PART I GENERAL

1.01 SECTION INCLUDES

- A. Storm drainage piping, fittings and accessories.
- B. Catch basins, junction boxes and drop inlets.

1.02 REFERENCES

- A. ANSI/ASTM C76 - Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.
- B. American Association of State Highway and Transportation Officials Specification M-196.

1.03 RELATED SECTIONS

- A. Section 2200 - Backfilling.
- B. Section 2300 - Trenching.
- C. Section 3100 - Concrete.

PART II PRODUCTS

2.01 DRAINAGE PIPE MATERIALS

- A. Reinforced Concrete Pipe: ANSI/ASTM C76, Class III with concrete pipe; mesh reinforcement and inside nominal diameter as shown on plans.

2.02 CATCH BASINS, DROP INLETS, JUNCTION BOX FRAMES AND GRATES

- A. Basin Lid and Frame: Cast iron construction, as specified on the plans.
- B. Manhole castings shall be cast iron meeting ASTM Serial Designation A48-62, Class 30B. They shall be "Anti-Rattle" type.
- C. Shaft construction to be 8" concrete brick or reinforced precast concrete basin sections, lipped male/female dry joints; nominal size, 4 feet square.

- D. Base Pad: Cast-in-place 3000 psi concrete leveled top surface to receive concrete brick or pre-cast concrete section.

2.03 JUNCTION BOXES

- A. Lid and Frame: Cast iron construction, removable lid, nominal lid and frame diameter of 24 inches as shown on the plans.
- B. Shaft construction to be 8" concrete brick or reinforced precast concrete basin sections, lipped male/female dry joints; nominal size, 4 feet square unless shown otherwise on the plans.
- C. Base Pad: Cast-in-place 3000 psi concrete leveled top surface to receive concrete brick or pre-cast concrete section.
- D. Manholes used as junction boxes shall have the following diameters based upon the largest size pipe:
 - 15" pipe4 feet
 - 18" pipe5 feet
- E. For larger pipes, pre-cast manhole junction boxes must have prior approval of the Engineer.
- F. Pre-cast concrete manholes shall meet ASTM Specifications, Serial Designation C478-64T or latest revision and have "O" ring gasket joints meeting ASTM Specifications, Serial Designation D443-65 or latest revision.

2.04 BRICK

- A. Brick shall meet ASTM Serial Designation C26 for common brick, Grade C.

2.05 CEMENT MORTAR JOINTS

- A. All concrete pipe shall be laid with cement mortar joints. The mortar mixture shall be one part portland cement and two parts clean sand by volume.
- B. Only enough water shall be used to make a stiff, workable mortar and no more than 5.5 gallons of water per sack of cement shall be used.

2.06 CONCRETE MATERIALS

- A. Portland Cement shall conform to Section 3250 and the specifications of ASTM, Serial Designation C-150-62 or latest revision.

- B. Cement shall be stored in a weather-tight enclosure.
- C. Hydrated lime shall meet the specifications of ASTM, Serial Designation C207-49, or latest revision.
- D. Fine aggregate shall conform to the following ASTM Specifications, latest revisions:
for concrete: Serial Designation C33-66T
for masonry mortar: Serial Designation C144-62T
- E. Coarse aggregate for concrete shall consist of crushed granite conforming to the current ASTM Specifications C33. Aggregate shall be cleaned, hard and uncoated.
- F. Water for mortar and concrete must not be contaminated by salt, oil, acid or other material which may be harmful.

2.07 REINFORCING STEEL

- A. Reinforcing steel shall be of the lengths and sizes shown on the plans.
- B. Reinforcing steel shall be of approved deformed type and meet all requirements of ASTM Standard Specifications for new Billet Steel Reinforcement Bars, serial Designation A150-62T. Bars will be structural or intermediate grade open hearth steel.

2.08 BACKFILL MATERIALS

- A. Reused or imported subsoil as specified in Section 2200 and approved by the Engineer.
- B. Type C for any pipe crossing beneath roadways.
- C. Type C shall be utilized in areas of poor soil conditions as directed by the Engineer.

PART III EXECUTION

3.01 EXAMINATION

- A. Contractor shall notify Engineer/Owner so the trench cut or excavation base can be verified if it is ready to receive work and excavations, dimensions and elevations are as indicated on drawings.
- B. Beginning of installation means acceptance of existing conditions.

3.02 PREPARATION

- A. Hand trim excavations to required elevations. Correct over excavation with fill material of fine aggregate.
- B. Remove large stones or other hard matter which could damage drainage tile or impede consistent backfilling or compaction.

3.03 INSTALLATION - PIPE

- A. Lay pipe to slope gradients noted on drawings with maximum variation from true slope of 1/8 inch in 10 feet.
- B. Increase compaction of each successive lift. Do not displace or damage pipe when compacting.
- C. Storm drain pipe and appurtenant structures shall be installed in accordance with Section 2300 - Trenching and Section 2200 - Backfilling.
- D. All pipe shall be laid with the bells uphill.
- E. Clean the pipe ends and wet before the joint is made.
- F. Apply stiff mortar to the lower half of the bell of the pipe already laid and the upper half of the tongue of the pipe to be laid. The joint shall then be made and drawn tight. Use of an approved joint sealant may be substituted for mortar.
- G. Additional mortar shall be applied to the outside to fill any unfilled portion of the groove.
- H. Backfill shall be done so as not to disturb the mortar joints.
- I. Fill must be approved by the Engineer/Owner before placement.
- J. Spoil from the excavation may not be utilized at these locations unless specifically approved by the Engineer/Owner.
- K. In all locations where storm water drainage pipe crosses beneath roadways, select granular sand fill shall be used to backfill above the pipe.
- L. When completed, each pipe line shall show a neat circular bore when lamped.
- M. All perforated pipe shall be backfilled with select backfill material and compacted.

- N. Prior to placing perforated pipe and after the trench has been excavated an approved construction fabric will be placed in the trench and wrapped around the pipe, the perforated pipe placed, backfill over pipe with select material and compact.

3.04 INSTALLATION - CATCH BASINS, DROP INLETS AND JUNCTION BOXES

- A. Form bottom of excavation clean and smooth to correct elevation.
- B. Form and place cast-in-place concrete base pad with provision for storm sewer pipe end sections.
- C. Establish elevations and pipe inverts for inlets and outlets as indicated.
- D. Mount lid and frame level in grout, secured to top cone section to elevation indicated.
- E. Inverts shall be smooth with uniform slopes from invert to invert.
- F. Brick structures shall have every fifth course of brick laid as headers. Other courses shall be stretchers.
- G. All mortar joints shall be full.
- H. Inside mortar joints shall be rubbed full and struck.
- I. The outside of the brick work shall be covered with 0.5 inches of mortar.

3.05 FIELD QUALITY CONTROL

- A. Testing shall be in accordance with Section 1400.

3.06 PROTECTION

- A. Protect pipe from damage or displacement until backfilling operation is in progress.
- B. Protect drainage piping and catch basins from siltation during construction by covering with filter fabric.

3.06 RELAID PIPE CULVERTS

- A. The work shall consist of carefully exposing, taking up, cleaning out and relaying the existing pipe sections to the lines and grades shown on the plans.

- B. Exercise care and use proper equipment in removing pipe. Pipe damaged through negligence, or improper handling, shall be replaced with new pipe at the contractor's expense.
- C. Pipe joint sealant shall be installed during assembly.

END OF SECTION

SECTION 2580 – PAVEMENT MARKINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Thermoplastic pavement markings.
- B. Latex pavement markings

1.02 RELATED SECTIONS

- A. Section 2400 – Asphaltic Concrete Pavement

1.03 REFERENCES

- A. SCDOT Standard Specifications, 2007 Edition
 - Section 627 – Thermoplastic Pavement Markings
 - Section 609 – Temporary Pavement Markings
 - Section 625 – Permanent Pavement Markings Fast Dry Waterborne Paint
- B. Federal Highway Administration Manual on Uniform Traffic Control Devices

PART 2 PRODUCTS

2.01 MATERIALS

- A. Use only thermoplastic markings which are of the hot, machine applied type. Use Alkyd/Maleic thermoplastic that is on the approved product list of SCDOT.
- B. Ensure that the temporary paint complies with the Specifications that apply to permanent paint in Subsection 625.2.

PART 3 EXECUTION

3.01 PREPARATION

- A. Sweep and clean surface to eliminate loose material and dust.

3.02 APPLICATION

- A. Apply the thermoplastic at the manufacture's recommended rate to achieve 90 mils for edgelines and centerlines. Apply the temporary paint at the manufacture's recommended rate to achieve 15 mils wet.
- B. Do not apply pavement marking materials over longitudinal joints.

C. Apply thermoplastic and temporary paint with mechanical equipment to produce uniform straight edges.

D. Protect the thermoplastic and temporary paint from traffic until tack free.

END OF SECTION

DIVISION 3

CONCRETE

SECTION 3100 – CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cast-in-place concrete for storm drainage system, paving, curb and gutter, slabs and walks.
- B. Reinforcing Steel.
- C. Concrete Curing.
- D. Concrete Repair.

1.02 RELATED SECTIONS

- A. Section 3150 - Concrete Curb and Sidewalk.
- B. Section 3300 - Concrete Curing

1.03 REFERENCES

- A. ACI 301 - Specifications for Structural Concrete for Buildings.
- B. ASTM C 33 - Concrete Aggregates.
- C. ASTM C 94 - Ready-Mixed Concrete.
- D. ASTM C 150 - Portland Cement.
- E. ASTM C 260 - Air-Entraining Admixtures for Concrete.
- F. ASTM C 494 - Chemical Admixtures for Concrete.
- G. ACI 315 - Details and Detailing of Concrete Reinforcement.
- H. ASTM A 82 - Cold Drawn Steel Wire for Concrete Reinforcement.
- I. ASTM A 185 - Welded Steel Wire Fabric for Concrete Reinforcement.
- J. ANSI/AWS D1.4 - Structural Welding Code Reinforcing Steel.
- K. ASTM A 615 - Deformed and Plain Billet Steel Bars for Concrete Reinforcement.
- L. CRSI - Manual of Practice.
- M. ASTM C 309 - Liquid Membrane - Forming Compounds for Curing Concrete.

- N. ASTM D 2103 - Polyethylene Film and Sheeting.
- O. FS TT-C-800 - Curing Compound, Concrete for New and Existing Surfaces.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with ACI 301.
- B. Obtain materials from same source throughout.

1.05 TESTS

- A. Testing and analysis of concrete will be performed under provisions of Section 1400.
- B. Submit proposed mix design of each class of concrete to Engineer for Review prior to commencement of work.
- C. Test of cement and aggregates will be performed to ensure conformance with requirements stated herein.

1.06 PRODUCT DATA

- A. Submit mill test certificates of supplied concrete reinforcing indicating physical and chemical analysis.
- B. Provide product data for specified products.
- C. Submit all manufacturer's installation instructions.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Do not place concrete in temperatures less than 40 degrees F without Engineer's approval.
- B. Maintain ambient temperature at 70 degrees F (minimum) for three days for curing.

PART 2 PRODUCTS

2.01 CONCRETE MATERIALS

- A. Cement: ASTM C150, normal - Type 1, air entraining - Type 1A moderate, high early strength Type III, air entraining - Type III Portland Type; gray color.
- B. Fine and Coarse Aggregates: ASTM C 33.
- C. Water: Clean and not detrimental to concrete.

2.02 ADMIXTURES

- A. Air Entrainment: ASTM C 260.
- B. Chemical Admixture: ASTM C 494 Type A - water reducing. Type B - retarding. Type C - accelerating. Type D - water reducing and retarding. Type E - water reducing and accelerating.

2.03 CONCRETE MIX

- A. Mix concrete in accordance with ASTM C 94.
- B. Provide concrete for all wingwall, footing and slab construction of the following characteristics:
 - 1. Comprehensive Strength
(7 days): 3200 psi
 - 2. Comprehensive Strength
(28 days): 4000 psi
- C. Provide concrete for All Other Concrete Construction of the following characteristics:

<u>Unit</u>	<u>Measurement</u>
Comprehensive Strength (7 days):	2400 psi
Comprehensive Strength (28 days):	3000 psi

- D. Use accelerating admixtures in cold weather only when approved by Engineer. Use of admixtures will not relax cold weather placement requirements.
- E. Use set-retarding admixtures during hot weather only when approved by Engineer.
- F. Add air entraining agent to all concrete mixes for concrete work.

2.04 REINFORCING STEEL MATERIALS

- A. Reinforcing Bars: ASTM A 615, 60 KSI yield grade, billet-steel deformed bars with uncoated finish as specified on the plans.
- B. Welded Steel Wire Fabric: ASTM A 185, plain type, coiled rolls, uncoated finish 6" x 6" mesh of 0.135" diameter.
- C. Stirrup Steel - ASTM A 82.
- D. Tie Wire: Minimum 16 gage annealed type - acceptable patented system.

- E. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during installation and placement of concrete.

2.05 CURING MATERIALS

- A. Water: Clean and not detrimental to concrete.
- B. Membrane Curing Compound: ASTM C 309, FSTT-C-800.
- C. Chem-trete curing compound by Trocal or equivalent.

PART 3 EXECUTION

3.01 INSPECTION

- A. Verify anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, held securely, and will not cause hardship in placing concrete.

3.02 PREPARATION

- A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent. Apply bonding agent in accordance with manufacturer's instructions.
- B. At locations where new concrete is dowelled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.
- C. Before placing concrete, clean reinforcement of foreign particles or coating and remove any foreign material in forms by sweeping, blowing or washing.

3.03 PLACING CONCRETE

- A. Notify Engineer minimum 24 hours prior to commencement of concreting operations.
- B. Place concrete in accordance with ACI 301.
- C. Hot Weather Placement: ACI 301.
- D. Cold Weather Placement: ACI 301.
- E. Ensure reinforcement, inserts, embedded parts, formed joints are not disturbed during concrete placement.
- F. Maintain concrete cover around reinforcing as follows:

<u>ITEM</u>	<u>COVERAGE</u>
Supported Slabs and Joists	2 inch
Walls (Exposed to Weather or Backfill)	2 inch
Footings & Concrete Formed Against Earth	2 inch

Slabs on Fill

2 inch

- G. Place concrete continuously between predetermined construction and control joints. Do not break or interrupt successive pours such that cold joints occur.
- H. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Engineer upon discovery.

3.04 FINISHING

- A. Provide concrete surfaces to be left exposed, concrete walls with sack rubbed finish or as directed by the Engineer.

3.05 PATCHING

- A. Notify Engineer immediately upon removal of forms.
- B. Patch imperfections.

3.06 DEFECTIVE CONCRETE

- A. Modify or replace concrete not conforming to required levels and lines, details and elevations.
- B. Repair or replace concrete not properly placed or of the specified type.

3.07 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 1400.
- B. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature and test samples taken.
- C. Frequency of tests: as required by the testing firm or as directed by the Engineer.

3.08 PROTECTION

- A. Protect all finished work.
- B. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures and mechanical injury.
- C. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

END OF SECTION

SECTION 3150 – CONCRETE CURB AND SIDEWALK

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cast-in-place concrete curb and gutter construction.

1.02 RELATED SECTIONS

- A. Section 2000 – Site Grading, Excavation, Filling & Compacting
- B. Section 3100 - Concrete.

1.03 REFERENCES

- A. ACI 347 - Recommended Practice for Concrete Form Work.
- B. PS 1 - Construction and Industrial Plywood.

1.04 QUALITY ASSURANCE

- A. Obtain materials from same source throughout.

1.05 ENVIRONMENTAL REQUIREMENTS

- A. Do not place concrete in temperatures less than 40 degrees F without Engineer's approval.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Concrete Materials: Comply with requirements of applicable Division 3 sections for concrete materials, curing materials and others as required.
- B. Forms: Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects. Use flexible spring steel forms or laminated boards to form radius bends as required. Coat forms with nonstaining type coating that will not discolor or deface surface of concrete.
- C. Joint Fillers: Resilient premolded bituminous impregnated fiberboard units complying with ASTM D 1751, FS HH-F-341, Type II, Class A; or AASHTO M 153, Type I.

2.02 MIX DESIGN

- A. Mix design shall comply with requirements of Section 3100.
- B. Design mix to produce normal weight concrete consisting of portland cement, aggregate, water-reducing admixture, air-entraining admixture, and water to produce the following properties:
 - 1. Compressive Strength: 3,000 psi, minimum at 28 days, unless otherwise indicated on Plans.
 - 2. Slump Range: 2" - 4" maximum.
 - 3. Air Entrainment: 5% to 8%.

PART 3 EXECUTION

3.01 INSPECTION

- A. Verify reinforcement and other items to be cast into concrete are accurately placed, held securely, and will not cause hardship in placing concrete.

3.02 PREPARATION

- A. Form Construction
 - 1. Set forms to required grades and lines, rigidly braced and secured.
 - 2. Clean forms after each use, coat with form release agent as often as required to ensure separation from concrete without damage.
- B. Concrete Placement
 - 1. Do not place concrete until subgrade and forms have been checked for line and grade.
 - 2. Place concrete using methods which prevent segregation of mix.
 - 3. Automatic machine may be used for curb and gutter placement at Contractor's option. Machine placement must produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete as specified.
 - 4. Mechanical slip forms shall be placed to the proper string grade.
 - 5. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Engineer upon discovery.

C. Joint Construction

1. Weakened Joints: Provide joints at intervals of 10 feet maximum each way. The joint shall be made by cutting the concrete with a trowel or by other acceptable methods.
2. Expansion Joints: Preformed expansion joints 3/4 or an inch thick, extending the full depth of the concrete curbing, shall be constructed at all radius points, junctions with existing concrete, inlets and manholes, and at not more than 100 foot intervals in continuous runs of curb. Place concrete continuously between predetermined expansion joints. Do not break or interrupt successive pours such that cold joints occur.

3.04 FINISHING

- A. Broom finish by drawing fine-hair broom across concrete surface parallel to line of traffic. Repeat procedure if required to provide fine line texture.

3.05 PATCHING

- A. Notify Engineer immediately upon removal of forms.
- B. Patch imperfections.

3.06 DEFECTIVE CONCRETE

- A. Modify or replace concrete not conforming to required levels and lines, details and elevations.
- B. Repair or replace concrete not properly placed or of the specified type.
- C. Remove and replace defective concrete as directed, at no additional cost to the Owner.

3.07 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 01400.

3.08 PROTECTION

- A. Protect concrete from damage until acceptance of work.

END OF SECTION

SECTION 3300 – CONCRETE CURING

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Concrete curing materials and methods.

1.02 RELATED WORK

- A. Section 03250 - Concrete.

1.03 REFERENCES

- A. ACI 301 - Specifications for Structural Concrete for Buildings.
- B. ASTM C 309 - Liquid Membrane-Forming Compounds for Curing Concrete.
- C. ASTM D 2103 - Polyethylene Film and Sheeting.
- D. FS TT-C-800 - Curing Compound, Concrete, for New and Existing Surfaces.

1.04 QUALITY ASSURANCE

- A. Conform to requirements of ACI 301.

1.05 PRODUCT DATA

- A. Submit all product data.
- B. Provide product data for specified products.
- C. Submit all manufacturers' installation instructions.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Maintain ambient temperature at 70 degrees F for three days.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Water: Clean and not detrimental to concrete.
- B. Absorptive Mat: Cotton fabric of 10 oz/sq. yd., clean, roll goods.
- C. Absorptive Mat: Burlap fabric of 10 oz/sq. yd., clean, roll goods.
- D. Membrane Curing Compound: ASTM C 309, FS TT-C-800.

- E. Polyethylene Film: ASTM D 2103, 6 mil thick; clear color.
- F. Chem-trete curing compound by Trocal or approved equal.

PART 3 EXECUTION

3.01 INSPECTION

- A. Verify concrete surfaces are ready for curing.

3.02 MEMBRANE CURING COMPOUND

- A. Apply curing compound in two coats.
- B. Apply in accordance with manufacturers' instructions.

3.03 ABSORPTIVE MAT

- A. Spread polyethylene film over slab areas. Lap edges and ends 3 inches and seal with pressure sensitive polyester tape.
- B. Maintain in place with plywood sheets for three days.

3.05 CURING

- A. Cure concrete.
- B. Remove absorptive mat, sheeting and ballast after curing.

END OF SECTION

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of all items off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 MATERIALS OWNERSHIP

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

1.4 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
 1. Inspect and discuss condition of construction to be selectively demolished.
 2. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 3. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 4. Review areas where existing construction is to remain and requires protection.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For refrigerant recovery technician.
- B. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property for dust control and, for noise control. Indicate proposed locations and construction of barriers.
- C. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's building manager's on-site operations are uninterrupted.
 - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- D. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.
- 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 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.
- G. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.

1.6 CLOSEOUT SUBMITTALS

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

1.7 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Owner of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain all existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.
- C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- E. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs.
 - 1. Comply with requirements specified in Section 013233 "Photographic Documentation."
 - 2. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions that might be misconstrued as damage caused by salvage operations.

3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 2. Arrange to shut off indicated utilities with utility companies.
 3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
- C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris- removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Comply with requirements for access and protection specified in Section 013100 "Project management and Coordination."
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 2. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of selective demolition.

3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level.
 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
 5. Maintain adequate ventilation when using cutting torches.
 6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 7. Dispose of demolished items and materials promptly.
- B. Removed and Salvaged Items:
1. Clean salvaged items.
 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 Owner's storage area off-site designated by Owner.
 5. Protect items from damage during transport and storage.

C. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least **3/4 inch** at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, then remove concrete between saw cuts.
- C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.
- E. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." **Do not use methods requiring solvent-based adhesive strippers.**
- F. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weatherproof. See Appropriate Specification Section for new roofing requirements.
1. Remove existing roof membrane, flashings, copings, and roof accessories.
 2. Remove existing roofing system down to substrate.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an-approved landfill.

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. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.7 CLEANING

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

END OF SECTION 024119

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Exterior steel pipe and tube railings.
 - 2. Aluminum pipe and tube railings.
- B. Related Sections:
 - 1. Section 033000 - Cast-In-Place Concrete
 - 2. Section 055100 - Metal Stairs, for steel tube railings associated with metal stairs.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide handrails and railings complying with requirements in ASTM 985 for structural performance, based on testing performed according to ASTM E 894 and ASTM E 935. Provide railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails:
 - a. Uniform load of 50 lbf/ ft. applied in any direction.
 - b. Concentrated load of 200 lbf applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. applied horizontally and concurrently with uniform load of 100 lbf/ft. applied vertically downward.
 - b. Concentrated load of 200 lbf applied at any point in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 3. Infill Area of Guards: Capable of withstanding a horizontal concentrated load of 200 lbf applied to 1 sq. ft. at any point in the system, including intermediate rails, balusters, or other elements composing infill area.
 - a. Load above need not be assumed to act concurrently with loads on top rails in determining stress on guards.

- B. Thermal Movements: Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures to prevent buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating dissimilar metals to prevent them and other materials from being in direct contact with each other.
- D. N.A.A.M.M. "Pipe Railing Manual".

1.4 QUALIFICATIONS

- A. Fabricator: Company specializing in performing the work of this Section with minimum 5 years documented experience.
- B. Installer: Company specializing in performing the work of this Section with minimum 5 years documented experience.
- C. Design connections not detailed on the Drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and in the State of South Carolina.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Grout, anchoring cement, and paint products.
 - 2. Manufacturer's product lines of mechanically connected railings.
- B. LEED Submittal:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - 2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material.
- C. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.

1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

- D. Welding certificates, certifying welders employed on the Work have obtained AWS qualification within the previous 12 months.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to the following:

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

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
2. Provide allowance for trimming, adjusting and fitting at site.

1.8 COORDINATION AND SCHEDULING

- A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Deliver handrails, guards and railing systems and related components in protective packaging and store components to avoid damage from moisture, abrasion and other construction activities.

- B. Protect finishes of railings from damage during construction period by applying a strippable temporary protective covering before shipping. Remove protective coverings at time of Substantial Completion.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace Aluminum components, that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failure
 - b. Finish: Noticable gloss and or color deterioration. Failure of the finish to adhere to the base metal.
 - 2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective components.
 - 3. Warranty Period for Factory finished railings: Life of installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces free from pitting, seam marks, roller marks, rolled trade names, stains, discolorations, or other blemishes where exposed to view on finished units.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.
- C. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than the following:
 - 1. W-Shapes: 80 percent.
 - 2. Channels and Angles: 80 percent.
 - 3. Plate and Bar: 25 percent.
 - 4. Cold-Formed Hollow Structural Sections: 25 percent.
- D. Regional Materials: Provide steel products that have been fabricated within 500 miles of Project site.

2.2 STEEL AND IRON

- A. Tubing: ASTM A500 (cold formed) or ASTM A513, Type 5 (mandrel drawn), Grade A, unless another grade is required by structural loads.

- B. Pipe: ASTM A53, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
- C. Plates, Shapes, and Bars: ASTM A36.

2.3 ALUMINUM

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.
- B. Extruded Bars and Tubing: ASTM B 221, Alloy 6005-T5.
- C. Extruded Structural Pipe and Round Tubing: ASTM B 429/B 429M, Alloy 6063-T6.
 - 1. Provide Standard Weight (Schedule 40) pipe, unless otherwise indicated.
- D. Drawn Seamless Tubing: ASTM B 210, Alloy 6063-T832.
- E. Plate and Sheet: ASTM B 209, Alloy 6061-T6.
- F. Die and Hand Forgings: ASTM B 247, Alloy 6061-T6.
- G. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.

2.4 WELDING MATERIALS, FASTENERS AND ANCHORS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
 - 1. For steel railings and fittings, use plated fasteners complying with ASTM B633, Class Fe/Zn 25 for electrodeposited zinc coating.
 - 2. For aluminum railings: Type 304 stainless-steel fasteners.
- C. Fasteners for Interconnecting Railing Components: Use fasteners fabricated from same basic metal as fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.
 - 1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.

- D. Anchors: Provide cast-in-place chemical or torque-controlled expansion anchors, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E488 conducted by a qualified independent testing agency.

2.5 MISCELLANEOUS MATERIALS

- A. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- B. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
- C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- D. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
 - 1. Water-Resistant Product: At exterior locations and where indicated provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.6 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Shear and punch metals cleanly and accurately. Remove burrs from exposed cut edges.
- D. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work. Remove sharp or rough areas on exposed surfaces.
- E. Form work true to line and level with accurate angles and surfaces.
- F. Fabricate connections that will be exposed to weather in a watertight manner. Provide weep holes or other means to drain entrapped water in hollow sections of railing

members that are exposed to exterior or to expel moisture from condensation or other sources.

- G. Cut, reinforce, drill, and tap components as indicated to receive finish hardware, screws, and similar items.
- H. Connections: Fabricate railings with welded connections, unless otherwise indicated.
- I. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld connections continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove flux immediately.
 - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- J. Form changes in direction as follows:
 - 1. As detailed.
 - 2. By bending.
 - 3. By radius bends of radius indicated.
 - 4. By flush radius bends.
 - 5. By mitering at elbow bends.
 - 6. By inserting prefabricated flush-elbow fittings.
 - 7. By any method indicated above, applicable to change in direction involved, as indicated on drawings.
- K. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- L. Close exposed ends of railing members with prefabricated end fittings.
- M. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- N. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work, unless otherwise indicated.
- O. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

- P. For railing posts set in concrete, provide steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with steel plate forming bottom closure.

2.7 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.8 ALUMINUM FINISHES

- A. Mechanical Finish: AA-M12 (Mechanical Finish: nonspecular as fabricated).
- B. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
- C. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 - 1. Color: Black, or as specified.
- D. Baked-Enamel or Powder-Coat Finish: AAMA 2604 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Color: Black, or as specified.
- E. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Minimum dry film thickness of 3 mils. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Color: Black, or as specified.

2.9 STEEL AND IRON FINISHES

- A. Galvanized Railings: Hot-dip galvanize exterior steel and iron railings, including hardware, after fabrication. Galvanize items to comply with applicable standard listed below:
 - 1. ASTM A123, for galvanizing steel and iron products.
 - 2. ASTM A153, for galvanizing steel and iron hardware.
- B. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- C. For galvanized railings, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free from rack.
 - 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without architect approval.
 - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
 - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- C. Adjust railings before anchoring to ensure matching alignment at abutting joints. Space posts at intervals indicated, but not less than that required by structural loads.
- D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

- A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in Part 2 "Fabrication" Article whether welding is performed in the shop or in the field.
- B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve

extending 2 inches beyond joint on either side, fasten internal sleeve securely to 1 side, and locate joint within 6 inches of post.

3.3 ANCHORING POSTS

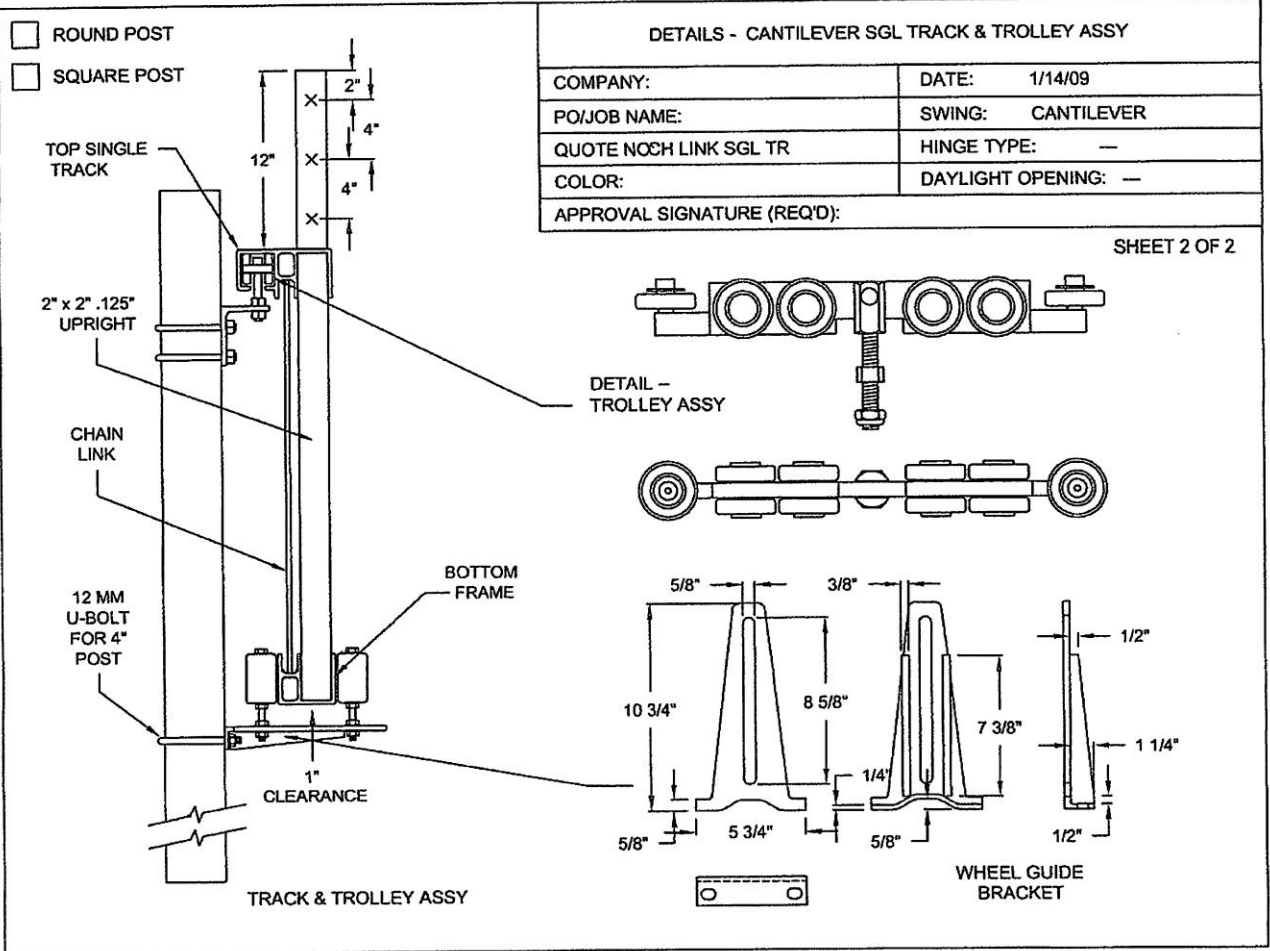
- A. Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.
- C. Leave anchorage joint exposed; wipe off surplus anchoring material; and leave 1/8-inch buildup, sloped away from post.

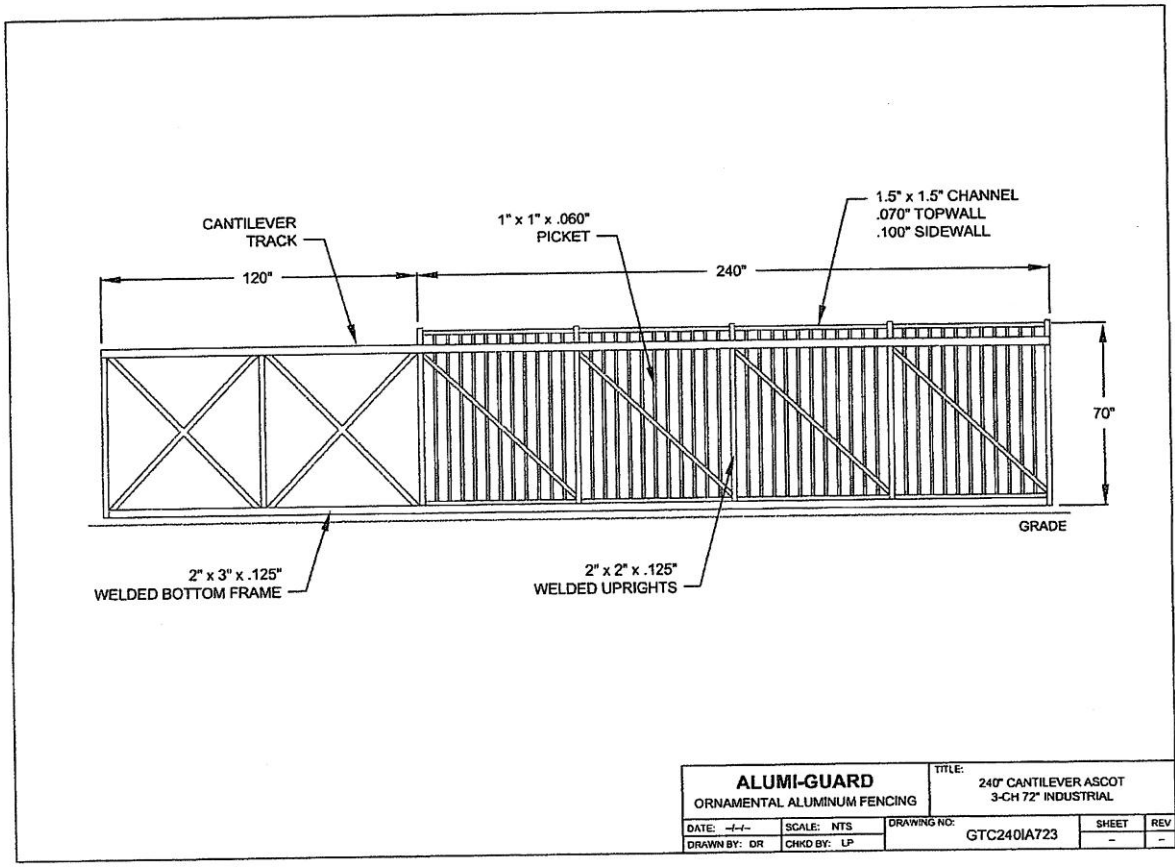
3.4 ATTACHING HANDRAILS TO WALLS

- A. Attach handrails to wall with wall brackets. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface.
 - 1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
- B. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- C. Secure wall brackets to building construction as follows:
 - 1. For solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - 2. For hollow masonry anchorage, use toggle bolts.

3.5 ADJUSTING AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780.





END OF SECTION 055213

SECTION 323113 - CHAIN LINK FENCES AND GATES

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. Chain-link fences.
 - 2. Gates: horizontal slide and/or swing.
- B. Related Sections:
 - 1. Section 033053 "Miscellaneous Cast-in-Place Concrete" for cast-in-place concrete post footings.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design chain-link fences and gates, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Chain-link fence and gate framework shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to ASCE/SEI 7:
 - 1. Minimum Post Size: Determine according to ASTM F 1043 for framework up to 12 feet high, and post spacing not to exceed 10 feet for Heavy Industrial Fence .
 - 2. Minimum Post Size and Maximum Spacing: (For systems above 12 feet high) Determine according to CLFMI WLG 2445, based on mesh size and pattern specified and on the following:
 - a. Wind Loads and Exposure: Per International Building Code.
 - b. Material Group: Schedule 40 steel pipe, electric-resistance-welded round steel pipe.
- C. Lightning Protection System: Maximum grounding-resistance value of 25 ohms under normal dry conditions.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for chain-link fences and gates.

1. Fence and gate posts, rails, and fittings.
 2. Chain-link fabric, reinforcements, and attachments.
 3. Gates and hardware.
 4. Gate operators, including operating instructions.
 5. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Show accessories, hardware, gate operation, and operational clearances.
1. Gate Operator: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Initial Selection: For components with factory-applied color finishes.
- D. Samples for Verification: Prepared on Samples of size indicated below:
1. Polymer-Coated Components: In 6-inch lengths for components and on full-sized units for accessories.
- E. Delegated-Design Submittal: For chain-link fences and gate framework indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified factory-authorized service representative.
- B. Product Certificates: For each type of chain-link fence, operator, and gate, from manufacturer.
- C. Product Test Reports: For framing strength according to ASTM F 1043.
- D. Field quality-control reports.
- E. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For the following to include in emergency, operation, and maintenance manuals:
 1. Polymer finishes.
 2. Gate hardware.
 3. Gate operator.

1.7 QUALITY ASSURANCE

- A. Fencing Contractor: Been in the business of fencing for minimum of Five (5) years producing products as specified.
 1. Fencing to be provided as a complete system produced by the manufacturer, including necessary erection accessories, fittings and fasteners.

2. Contractor must maintain an office within 45 miles of the project site.
 3. Contractor to utilize installer certified by the fencing manufacturer and have a minimum of three years experience installing specified products.
- B. Testing Agency Qualifications: For testing fence grounding. Member company of NETA or an NRTL.
1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Emergency Access Requirements: Comply with requirements of authorities having jurisdiction for gates with automatic gate operators serving as a required means of access.
- E. Mockups: Build mockups to set quality standards for fabrication and installation.
1. Include 10-foot length of fence and gate.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer and Installer agrees to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Faulty operation of gate operators and controls.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - c. Delamination of vinyl coatings.
 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CHAIN-LINK FENCE FABRIC

- A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist. Comply with CLFMI Product Manual and with requirements indicated below:
1. Fabric Height: As indicated on Drawings.

2. **PROVIDE POLYMER-COATED FABRIC UNLESS NOTED OTHERWISE ON THE DRAWINGS.**
3. Steel Wire Fabric: Wire with a diameter of 9 Gauge - 0.148 inch.
 - a. Mesh Size: 1-3/4 inches.
 - b. Polymer-Coated Fabric: ASTM F 668, Class 1 Class 2a over zinc-coated steel wire.
 - 1) Color: As selected by Architect from manufacturer's full range, complying with ASTM F 934.
 - c. Zinc-Coated Fabric: ASTM A 392, Type II, Class 1, 1.2 oz./sq. ft. with zinc coating applied before weaving.
 - d. Coat selvage ends of fabric that is metallic coated before the weaving process with manufacturer's standard clear protective coating.
4. Selvage: Knuckled at both selvages.

2.2 FENCE FRAMING

- A. Posts and Rails: Comply with ASTM F 1043 for framing, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F 1043 or ASTM F 1083 based on the following:
 1. Fence Height: As indicated on Drawings. (up to 12' high fencing).
 2. **PROVIDE POLYMER-COATED COMPONENTS UNLESS NOTED OTHERWISE ON THE DRAWINGS.**
 3. Heavy Industrial Strength: Material Schedule 40 Group IC, round steel pipe, electric-resistance-welded pipe.
 4. Fence components: (**up to 4' tall**)
 - a. Line Post: 1.9 inches.
 - b. End, Corner and Pull Post: 2.375 inches.
 5. Fence components: (**above 4' to 6' tall**)
 - a. Line Post: 2.375 inches.
 - b. End, Corner and Pull Post: 2.875 inches.
 6. Fence components: (**above 6' to 12' tall**)
 - a. Line Post: 2.875 inches.
 - b. End, Corner and Pull Post: 3.5 inches.

7. Horizontal Framework Members: Top rails complying with ASTM F 1043.
 - a. Top Rail: 1.66 inches in diameter.
8. Brace Rails: Comply with ASTM F 1043.
9. Polymer coating over metallic coating.
 - a. Color: Match chain-link fabric as selected by Architect from manufacturer's full range, complying with ASTM F 934.
10. Metallic Coating for Steel Framing:
 - a. Type A, consisting of not less than minimum 2.0-oz./sq. ft. average zinc coating per ASTM A 123/A 123M or 4.0-oz./sq. ft. zinc coating per ASTM A 653/A 653M.

2.3 TENSION WIRE

- A. Polymer-Coated Steel Wire: 0.177-inch- diameter, tension wire complying with ASTM F 1664, Class 1 over zinc-coated steel wire.
 1. Color: Match chain-link fabric as selected by Architect from manufacturer's full range], complying with ASTM F 934.

2.4 SWING GATES

- A. General: Comply with ASTM F 900 for gate posts and single and / or double swing gate types. Provide automated vehicular gates that comply with ASTM F 2200.
 1. Gate Leaf Width: As indicated.
 2. Gate Fabric Height: 72 inches or less as indicated.
- B. Pipe and Tubing:
 1. Zinc-Coated Steel: Comply with ASTM F 1043 and ASTM F 1083; protective coating and finish to match fence framing.
 2. Gate Posts: Round tubular steel
 3. Gate Frames and Bracing: Round tubular steel.
- C. Frame Corner Construction: Welded.
- D. Hardware:
 1. Hinges: 360-degree inward and outward swing.
 2. Latches permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.

2.5 FITTINGS

- A. General: Comply with ASTM F 626.

- B. Post Caps: Provide for each post.
 - 1. Provide line post caps with loop to receive tension wire or top rail.
- C. Rail and Brace Ends: For each gate, corner, pull, and end post.
- D. Rail Fittings: Provide the following:
 - 1. Top Rail Sleeves: Pressed-steel or round-steel tubing not less than 6 inches long.
- E. Tension and Brace Bands: Pressed steel.
- F. Tension Bars: Steel, length not less than 2 inches shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.
- G. Truss Rod Assemblies: Steel, hot-dip galvanized after threading rod and turnbuckle or other means of adjustment.
- H. Tie Wires, Clips, and Fasteners: According to ASTM F 626.
 - 1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, complying with the following:
 - a. Hot-Dip Galvanized Steel: 0.106-inch- diameter wire; galvanized coating thickness matching coating thickness of chain-link fence fabric.
- I. Finish:
 - 1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz. /sq. ft. zinc.
 - a. Polymer coating over metallic coating.

2.6 GROUT AND ANCHORING CEMENT

- A. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout, recommended in writing by manufacturer, for exterior applications.
- B. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended in writing by manufacturer, for exterior applications.

2.7 FENCE GROUNDING

- A. Conductors: Bare, solid wire for No. 6 AWG and smaller; stranded wire for No. 4 AWG and larger.
 - 1. Material above Finished Grade: Copper.
 - 2. Material on or below Finished Grade: Copper.

3. Bonding Jumpers: Braided copper tape, 1 inch wide, woven of No. 30 AWG bare copper wire, terminated with copper ferrules.
- B. Connectors and Grounding Rods: Comply with UL 467.
1. Connectors for Below-Grade Use: Exothermic welded type.
 2. Grounding Rods: Copper-clad steel, 5/8 by 96 inches.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for a verified survey of property lines and legal boundaries, site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.
1. Do not begin installation before final grading is completed unless otherwise permitted by Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 250 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 INSTALLATION, GENERAL

- A. Install chain-link fencing to comply with ASTM F 567 and more stringent requirements indicated.
1. Install fencing on established boundary lines inside property line.

3.4 CHAIN-LINK FENCE INSTALLATION

- A. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.
- B. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
 2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
 - a. Concealed Concrete: Top 2 inches below grade to allow covering with surface material.
 - b. Posts Set into Concrete in Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed

and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.

- c. Posts Set into Voids in Concrete: Form or core drill holes not less than 5 inches deep and 3/4 inch larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.
- C. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment of 10 degrees or more.
- D. Line Posts: Space line posts uniformly at 10 feet o.c.
- E. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.
 1. Locate horizontal braces at midheight of fabric 72 inches or higher, on fences with top rail and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.
- F. Tension Wire: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch- diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches o.c. Install tension wire in locations indicated before stretching fabric. Provide horizontal tension wire at the following locations:
 1. Extended along bottom of fence fabric. Install top tension wire through post cap loops. Install bottom tension wire within 6 inches of bottom of fabric and tie to each post with not less than same diameter and type of wire.
- G. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.
- H. Intermediate and Bottom Rails: Install and secure to posts with fittings.
- I. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 1 inch between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.
- J. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than 15 inches o.c.
- K. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric per ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.
 1. Maximum Spacing: Tie fabric to line posts at 12 inches o.c. and to braces at 24 inches o.c.

- L. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

3.5 GATE INSTALLATION

- A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.6 GROUNDING AND BONDING

- A. Fence Grounding: Install at maximum intervals of 1500 feet except as follows:
 - 1. Fences within 100 Feet of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 feet.
 - a. Gates and Other Fence Openings: Ground fence on each side of opening.
 - 1) Bond metal gates to gate posts.
 - 2) Bond across openings, with and without gates, except openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches below finished grade.
- B. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a maximum distance of 150 feet on each side of crossing.
- C. Fences Enclosing Electrical Power Distribution Equipment: Ground as required by IEEE C2 unless otherwise indicated.
- D. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at the grounding location, including the following:
 - 1. Make grounding connections to each barbed wire strand with wire-to-wire connectors designed for this purpose.
 - 2. Make grounding connections to each barbed tape coil with connectors designed for this purpose.
- E. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.
- F. Connections: Make connections to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 - 4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.

5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

G. Bonding to Lightning Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning protection down conductor or lightning protection grounding conductor complying with NFPA 780.

3.7 FIELD QUALITY CONTROL

A. Grounding-Resistance Testing: Engage a qualified testing agency to perform tests and inspections.

1. Grounding-Resistance Tests: Subject completed grounding system to a megger test at each grounding location. Measure grounding resistance no fewer than two full days after last trace of precipitation, without soil having been moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural grounding resistance. Perform tests by two-point method according to IEEE 81.

2. Excessive Grounding Resistance: If resistance to grounding exceeds specified value, notify Architect promptly. Include recommendations for reducing grounding resistance and a proposal to accomplish recommended work.

3. Report: Prepare test reports certified by a testing agency of grounding resistance at each test location. Include observations of weather and other phenomena that may affect test results.

3.8 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Lubricate hardware and other moving parts.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's personnel to adjust, operate, and maintain chain-link fences and gates.

END OF SECTION 323113

SECTION 328400 - PLANTING IRRIGATION

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. Piping.
 - 2. Encasement for piping.
 - 3. Manual valves.
 - 4. Pressure-reducing valves.
 - 5. Automatic control valves.
 - 6. Automatic drain valves.
 - 7. Transition fittings.
 - 8. Dielectric fittings.
 - 9. Miscellaneous piping specialties.
 - 10. Sprinklers.
 - 11. Quick couplers.
 - 12. Drip irrigation specialties.
 - 13. Controllers.
 - 14. Boxes for automatic control valves.

1.3 DEFINITIONS

- A. Circuit Piping: Downstream from control valves to sprinklers, specialties, and drain valves. Piping is under pressure during flow.
- B. Drain Piping: Downstream from circuit-piping drain valves. Piping is not under pressure.
- C. Main Piping: Downstream from point of connection to water distribution piping to, and including, control valves. Piping is under water-distribution-system pressure.
- D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.4 PERFORMANCE REQUIREMENTS

- A. Irrigation zone control shall be automatic operation with controller and automatic control valves.
- B. Location of Sprinklers and Specialties: Design location is approximate. Make minor adjustments necessary to avoid plantings and obstructions such as signs and light standards. Maintain 100 percent irrigation coverage of areas indicated.

- C. Delegated Design: Design 100 percent coverage irrigation system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- D. Minimum Working Pressures: The following are minimum pressure requirements for piping, valves, and specialties unless otherwise indicated:
 - 1. Irrigation Main Piping: 200 psig.
 - 2. Circuit Piping: 150 psig.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Wiring Diagrams: For power, signal, and control wiring.
- C. Delegated-Design Submittal: For irrigation systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Irrigation systems, drawn to scale, on which components are shown and coordinated with each other, using input from Installers of the items involved. Also include adjustments necessary to avoid plantings and obstructions such as signs and light standards.
- B. Qualification Data: For qualified Installer.
- C. Zoning Chart: Show each irrigation zone and its control valve.
- D. Controller Timing Schedule: Indicate timing settings for each automatic controller zone.
- E. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sprinklers, controllers and automatic control valves to include in 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. Impact Sprinklers: Equal to 2 percent of amount installed for each type and size indicated, but no fewer than 5 units.
 - 2. Spray Sprinklers: Equal to 2 percent of amount installed for each type and size indicated, but no fewer than 5 units.

3. Bubblers: Equal to 2 percent of amount installed for each type indicated, but no fewer than 5 units.
4. Emitters: Equal to 2 percent of amount installed for each type indicated, but no fewer than 5 units.
5. Drip-Tube System Tubing: Equal to 5 percent of total length installed for each type and size indicated, but not less than 100 feet.
6. Soaker Tubes: Equal to 5 percent of total length installed for each type and size indicated, but not less than 50 feet.

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers that include a Professional Class member of the American Society of Irrigation Consultants.
- B. 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.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.11 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 1. Notify Architect and Owner no fewer than two days in advance of proposed interruption of water service.
 2. Do not proceed with interruption of water service without Architect's and Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Comply with requirements in the piping schedule for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.
- B. PVC Pipe: ASTM D 1785, PVC 1120 compound, Schedule 40.
 1. PVC Socket Fittings: ASTM D 2466, Schedule 40.
 2. PVC Threaded Fittings: ASTM D 2464, Schedule 80.
 3. PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket ends.
- C. PVC Pipe, Pressure Rated: ASTM D 2241, PVC 1120 compound, SDR 21.

1. PVC Socket Fittings: ASTM D 2467, Schedule 80.
2. PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket or threaded ends.

2.2 PIPING JOINING MATERIALS

- A. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- B. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.3 MANUAL VALVES

- A. Curb Valves:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Amcast Industrial Corporation; Lee Brass Company.
 - b. Ford Meter Box Company, Inc. (The).
 - c. Jones, James Company.
 - d. McDonald, A. Y. Mfg. Co.
 - e. Mueller Co.; Water Products Division.
 - f. Red Hed Manufacturing & Supply.
 2. Description:
 - a. Standard: AWWA C800.
 - b. NPS 1 and Smaller Pressure Rating: 100 psig.
 - c. NPS 1-1/4 to NPS 2 Pressure Rating: 80 psig minimum.
 - d. Body Material: Brass or bronze with ball or ground-key plug.
 - e. End Connections: Matching piping.
 - f. Stem: With wide-tee head.
- B. Curb-Valve Casing:
 1. Standard: Similar to AWWA M44 for cast-iron valve casings.
 2. Top Section: Telescoping, of length required for depth of burial of curb valve.
 3. Barrel: Approximately 3-inch diameter.
 4. Plug: With lettering "WATER."
 5. Bottom Section: With base of size to fit over valve.
 6. Base Support: Concrete collar.
- C. Shutoff Rods for Curb-Valve Casings: Furnish two steel, tee-handle shutoff rod(s) with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve for Project.
- D. Plastic Ball Valves:
 1. Description:

- a. Standard: MSS SP-122.
- b. Pressure Rating: 125 psig minimum.
- c. Body Material: PVC.
- d. Type: Union.
- e. End Connections: Socket or threaded.
- f. Port: Full.

2.4 PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Description:

- a. Standard: ASSE 1003.
- b. Body Material: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
- c. Pressure Rating: Initial pressure of 150 psig.
- d. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

2. Capacities and Characteristics:

- a. Size, Design Flow Rate, Design Inlet Pressure and Design Outlet Pressure Setting to be as determined by the Irrigation system design or as indicated on the drawings.

2.5 AUTOMATIC CONTROL VALVES

A. Plastic, Automatic Control Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Hunter Industries Incorporated.
 - b. Rain Bird Corporation.
 - c. Toro Company (The); Irrigation Division.
2. Description: Molded-plastic body, normally closed, diaphragm type with manual-flow adjustment, and operated by 24-V ac solenoid.

2.6 AUTOMATIC DRAIN VALVES

- ### A. Description: Spring-loaded-ball type of corrosion-resistant construction and designed to open for drainage if line pressure drops below 2-1/2 to 3 psig.

2.7 TRANSITION FITTINGS

- ### A. General Requirements: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

B. Transition Couplings:

1. Description: AWWA C219, metal sleeve-type coupling for underground pressure piping.

- C. Plastic-to-Metal Transition Fittings:
 - 1. Description: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-socket or threaded end.
- D. Plastic-to-Metal Transition Unions:
 - 1. Description: MSS SP-107, PVC four-part union. Include one brass threaded end, one solvent-cement-joint or threaded plastic end, rubber O-ring, and union nut.

2.8 MISCELLANEOUS PIPING SPECIALTIES

- A. Water Hammer Arresters: ASSE 1010 or PDI WH 201, with bellows or piston-type pressurized cushioning chamber and in sizes complying with PDI WH 201, Sizes A to F.
- B. Pressure Gages: ASME B40.1. Include 4-1/2-inch-diameter dial, dial range of two times system operating pressure, and bottom outlet.

2.9 SPRINKLERS

- A. General Requirements: Designed for uniform coverage over entire spray area indicated at available water pressure.
- B. Plastic, Pop-up, Gear-Drive Rotary Sprinklers:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Hunter Industries Incorporated.
 - b. Rain Bird Corporation.
 - c. Toro Company (The); Irrigation Division.
 - 2. Description:
 - a. Body Material: ABS.
 - b. Nozzle: ABS.
 - c. Retraction Spring: Stainless steel.
 - d. Internal Parts: Corrosion resistant.
- C. Plastic, Pop-up, Impact-Drive Rotary Sprinklers:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Champion Irrigation Products.
 - b. Toro Company (The); Irrigation Division.
 - 2. Description:
 - a. Case: ABS.
 - b. Pop-up Height: Approximately 3 inches .
 - c. Sprinkler Construction: ABS and other corrosion-resistant metals.
- D. Plastic, Pop-up Spray Sprinklers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Hunter Industries Incorporated.
 - b. Rain Bird Corporation.
 - c. Toro Company (The); Irrigation Division.
2. Description:
 - a. Body Material: ABS.
 - b. Nozzle: Brass.
 - c. Retraction Spring: Stainless steel.
 - d. Internal Parts: Corrosion resistant.
 - e. Pattern: Fixed, with flow adjustment.

E. Plastic Shrub Sprinklers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Hunter Industries Incorporated.
 - b. Toro Company (The); Irrigation Division.
2. Description:
 - a. Body Material: ABS or other plastic.
 - b. Pattern: Fixed, with flow adjustment.

2.10 DRIP IRRIGATION SPECIALTIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Rain Bird Corporation.
 2. Toro Company (The); Irrigation Division.
- B. Freestanding Emitters: Device to deliver water at approximately 20 psig.
 1. Body Material: PE or vinyl, with flow control.
 2. Riser to Emitter: PE or PVC flexible tubing.
 3. Capacities and Characteristics:
 - a. Flow: 1 gph at approximately 20 psig.
 - b. Tubing: PE or PVC; 1/8-inch minimum ID.
- C. Off-Ground Supports: Plastic stakes.
- D. Application Pressure Regulators: Brass or plastic housing, NPS 3/4, with corrosion-resistant internal parts; capable of controlling outlet pressure to approximately 20 psig.
- E. Filter Units: Brass or plastic housing, with corrosion-resistant internal parts; of size and capacity required for devices downstream from unit.
- F. Air Relief Valves: Brass or plastic housing, with corrosion-resistant internal parts.
- G. Vacuum Relief Valves: Brass or plastic housing, with corrosion-resistant internal parts.

2.11 CONTROLLERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Hunter Industries Incorporated.
 2. Rain Bird Corporation.
 3. Toro Company (The); Irrigation Division.
- B. Description:
1. Controller Stations for Automatic Control Valves: Each station is variable from approximately 5 to 60 minutes. Include switch for manual or automatic operation of each station.
 2. Exterior Control Enclosures: NEMA 250, Type 4, weatherproof, with locking cover and two matching keys; include provision for grounding.
 - a. Body Material: Molded plastic.
 - b. Mounting: Surface type for wall.
 3. Interior Control Enclosures: NEMA 250, Type 12, dripproof, with locking cover and two matching keys.
 - a. Body Material: Molded plastic.
 - b. Mounting: Surface type for wall.
 4. Control Transformer: 24-V secondary, with primary fuse.
 5. Timing Device: Adjustable, 24-hour, 14-day clock, with automatic operations to skip operation any day in timer period, to operate every other day, or to operate two or more times daily.
 - a. Manual or Semiautomatic Operation: Allows this mode without disturbing preset automatic operation.
 - b. Nickel-Cadmium Battery and Trickle Charger: Automatically powers timing device during power outages.
 - c. Surge Protection: Metal-oxide-varistor type on each station and primary power.
 6. Moisture Sensor: Adjustable from one to seven days, to shut off water flow during rain.
 7. Wiring: UL 493, Type UF multiconductor, with solid-copper conductors; insulated cable; suitable for direct burial.
 - a. Feeder-Circuit Cables: No. 12 AWG minimum, between building and controllers.
 - b. Low-Voltage, Branch-Circuit Cables: No. 14 AWG minimum, between controllers and automatic control valves; color-coded different from feeder-circuit-cable jacket color; with jackets of different colors for multiple-cable installation in same trench.
 - c. Splicing Materials: Manufacturer's packaged kit consisting of insulating, spring-type connector or crimped joint and epoxy resin moisture seal; suitable for direct burial.

2.12 BOXES FOR AUTOMATIC CONTROL VALVES

- A. Plastic Boxes:
1. Description: Box and cover, with open bottom and openings for piping; designed for installing flush with grade.

- a. Size: As required for valves and service.
- b. Shape: Rectangular.
- c. Sidewall Material: PE, ABS, or FRP.
- d. Cover Material: PE, ABS, or FRP.

1) Lettering: "IRRIGATION"

B. Polymer-Concrete Boxes:

1. Description: Box and cover, with open bottom and openings for piping; designed for installing flush with grade.

- a. Size: As required for valves and service.
- b. Shape: Rectangular.
- c. Sidewall Material: Polymer concrete with lateral and vertical sidewall design loading of 5000 lb minimum over 10 by 10 inches square.
- d. Cover Material: Polymer concrete with cover design loading of 5000 lb square.

1) Lettering: "IRRIGATION."

C. Drainage Backfill: Cleaned gravel or crushed stone, graded from 3/4 inch minimum to 3 inches maximum.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."
- B. Install warning tape directly above pressure piping, 12 inches below finished grades, except 6 inches below subgrade under pavement and slabs.
- C. Drain Pockets: Excavate to sizes indicated. Backfill with cleaned gravel or crushed stone, graded from 3/4 to 3 inches, to 12 inches below grade. Cover gravel or crushed stone with sheet of asphalt-saturated felt and backfill remainder with excavated material.
- D. Provide minimum cover over top of underground piping according to the following:
 - 1. Irrigation Main Piping: Minimum depth of 36 inches below finished grade, or not less than 18 inches below average local frost depth, whichever is deeper.
 - 2. Circuit Piping: 12 inches.
 - 3. Drain Piping: 12 inches.
 - 4. Sleeves: 24 inches.

3.2 PREPARATION

- A. Set stakes to identify locations of proposed irrigation system. Obtain Architect's approval before excavation.

3.3 PIPING INSTALLATION

- A. Location and Arrangement: Drawings indicate location and arrangement of piping systems. Install piping as indicated unless deviations are approved on Coordination Drawings.
- B. Install piping at minimum uniform slope of 0.5 percent down toward drain valves.
- C. Install piping free of sags and bends.
- D. Install groups of pipes parallel to each other, spaced to permit valve servicing.
- E. Install fittings for changes in direction and branch connections.
- F. Install unions adjacent to valves and to final connections to other components with NPS 2 or smaller pipe connection.
- G. Install flanges adjacent to valves and to final connections to other components with NPS 2-1/2 or larger pipe connection.
- H. Install underground thermoplastic piping according to ASTM D 2774 and ASTM F 690.
- I. Install expansion loops in control-valve boxes for plastic piping.
- J. Lay piping on solid subbase, uniformly sloped without humps or depressions.
- K. Install PVC piping in dry weather when temperature is above 40 deg F. Allow joints to cure at least 24 hours at temperatures above 40 deg F before testing.
- L. Install water regulators with shutoff valve and strainer on inlet and pressure gage on outlet. Install shutoff valve on outlet. Install aboveground or in control-valve boxes.
- M. Water Hammer Arresters: Install between connection to building main and circuit valves aboveground or in control-valve boxes.
- N. Install piping in sleeves under parking lots, roadways, and sidewalks.
- O. Install sleeves made of Schedule 40 PVC pipe and socket fittings, and solvent-cemented joints.
- P. Install transition fittings for plastic-to-metal pipe connections according to the following:
 - 1. Underground Piping:
 - a. NPS 1-1/2 and Smaller: Plastic-to-metal transition fittings.
 - b. NPS 2 and Larger: AWWA transition couplings.
 - 2. Aboveground Piping:
 - a. NPS 2 and Smaller: Plastic-to-metal transition fittings.
 - b. NPS 2 and Larger: Use dielectric flange kits with one plastic flange.

3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. PVC Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. PVC Pressure Piping: Join schedule number, ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 3. PVC Nonpressure Piping: Join according to ASTM D 2855.

3.5 VALVE INSTALLATION

- A. Underground Curb Valves: Install in curb-valve casings with tops flush with grade.
- B. Underground Iron Gate Valves, Resilient Seat: Comply with AWWA C600 and AWWA M44. Install in valve casing with top flush with grade.
 - 1. Install valves and PVC pipe with restrained, gasketed joints.
- C. Aboveground Valves: Install as components of connected piping system.
- D. Pressure-Reducing Valves: Install in boxes for automatic control valves or aboveground between shutoff valves. Install full-size valved bypass.
- E. Throttling Valves: Install in underground piping in boxes for automatic control valves.
- F. Drain Valves: Install in underground piping in boxes for automatic control valves.

3.6 SPRINKLER INSTALLATION

- A. Install sprinklers after hydrostatic test is completed.
- B. Install sprinklers at manufacturer's recommended heights.
- C. Locate part-circle sprinklers to maintain a minimum distance of 4 inches from walls and 2 inches from other boundaries unless otherwise indicated.

3.7 DRIP IRRIGATION SPECIALTY INSTALLATION

- A. Install freestanding emitters on pipe riser to mounting height indicated.

3.8 AUTOMATIC IRRIGATION-CONTROL SYSTEM INSTALLATION

- A. Equipment Mounting: Install interior controllers on wall.
 - 1. Place and secure anchorage devices. Use 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.
- B. Equipment Mounting: Install exterior freestanding controllers on precast concrete bases.
 - 1. Place and secure anchorage devices. Use 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.
- C. Install control cable in same trench as irrigation piping and at least 2 inches below or beside piping. Provide conductors of size not smaller than recommended by controller manufacturer. Install cable in separate sleeve under paved areas.

3.9 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221113 "Facility Water Distribution Piping" for water supply from exterior water service piping, water meters, protective enclosures, and backflow preventers. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment, valves, and devices to allow service and maintenance.
- C. Connect wiring between controllers and automatic control valves.

3.10 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on each automatic controller.
 - 1. Text: In addition to identifying unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
- C. Warning Tapes: Arrange for installation of continuous, underground, detectable warning tapes over underground piping during backfilling of trenches. See Section 312000 "Earth Moving" for warning tapes.

3.11 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, operate controllers and automatic control valves to confirm proper system operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Any irrigation product will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.12 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that controllers are installed and connected according to the Contract Documents.
3. Verify that electrical wiring installation complies with manufacturer's submittal.

3.13 ADJUSTING

A. Adjust settings of controllers.

B. Adjust automatic control valves to provide flow rate at rated operating pressure required for each sprinkler circuit.

C. Adjust sprinklers and devices, except those intended to be mounted aboveground, so they will be flush with, or not more than 1/2 inch above, finish grade.

3.14 CLEANING

A. Flush dirt and debris from piping before installing sprinklers and other devices.

3.15 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain automatic control valves and controllers.

3.16 PIPING SCHEDULE

A. Install components having pressure rating equal to or greater than system operating pressure.

B. Piping in control-valve boxes and aboveground may be joined with flanges or unions instead of joints indicated.

- C. Aboveground irrigation main piping, shall be one of the following:
 - 1. Galvanized-steel pipe and galvanized-steel pipe nipples; galvanized, gray-iron threaded fittings; and threaded joints.
 - 2. Schedule 40, PVC pipe; socket-type PVC fittings; and solvent-cemented joints.
 - 3. Schedule 80, PVC pipe; Schedule 80, threaded PVC fittings; and threaded joints.

- D. Underground irrigation main piping, shall be one of the following:
 - 1. Schedule 40 PVC pipe and socket fittings, and solvent-cemented joints.
 - 2. Schedule 80, PVC pipe; Schedule 80, threaded PVC fittings; and threaded joints.
 - 3. SDR 21, PVC, pressure-rated pipe; Schedule 80, PVC socket fittings; and solvent-cemented joints.

- E. Underground Branches and Offsets at Sprinklers and Devices: Schedule 80, PVC pipe; threaded PVC fittings; and threaded joints.
 - 1. Option: Plastic swing-joint assemblies, with offsets for flexible joints, manufactured for this application.

- F. Drain piping shall be the following:
 - 1. Schedule 40, PVC pipe and socket fittings; and solvent-cemented joints.

END OF SECTION 328400

SECTION 329113 - SOIL PREPARATION

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. Planting soils specified by composition of the mixes.
 - 2. Preparation of subsoil
 - 3. Soil Testing
 - 4. Placing topsoil
- B. Related Requirements:
 - 1. Section 311000 "Site Clearing" for topsoil stripping and stockpiling.
 - 2. Section 328400 "Planting Irrigation"
 - 3. Section 329200 "Turf and Grasses" for placing planting soil for turf and grasses.
 - 4. Section 329300 "Plants" for placing planting soil for plantings.

1.3 DEFINITIONS

- A. AAPFCO: Association of American Plant Food Control Officials.
- B. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.
- C. 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.
- D. Imported Soil: Soil that is transported to Project site for use.
- E. 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.
- F. 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."
- G. 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.
- H. SSSA: Soil Science Society of America.

- I. 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.
- J. 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.
- K. 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.

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 SUSTAINABLE DESIGN SUBMITTALS

- A. Section 18113.23 LEED for Schools
- B. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
 - 1. Materials Resources Certificates:
 - a. Certify source for regional materials and distance from Project site.
- C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
 - 1. Provide cost data for the following products:
 - a. Regional products
 - b. Recycled products

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction soil analyses on existing, on-site soil and proposed imported soil.
 - 1. Notify Architect seven days in advance of the dates and times when laboratory samples will be taken.
- B. Preconstruction Soil Analyses: For each unamended soil type, perform testing on soil samples and furnish soil analysis and a written report containing soil-amendment and fertilizer recommendations by a qualified testing agency performing the testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.
 - 1. Have testing agency identify and label samples and test reports according to sample collection and labeling requirements.

1.9 SOIL-SAMPLING REQUIREMENTS

- A. General: Extract soil samples according to requirements in this article.
- B. Sample Collection and Labeling: Have samples taken and labeled under the direction of the testing agency.
 - 1. Number and Location of Samples: Minimum of eight 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. Spilt each sample into two, equal parts. Send half to the testing agency and half to the Owner for their 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.

1.10 TESTING REQUIREMENTS

- A. General: Perform tests on soil samples according to requirements in this article.
- B. Physical Testing:
 - 1. Soil Texture
 - a. Soil-particle, size-distribution analysis according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods":
 - b. Total Porosity, Calculate using particle density and bulk density according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."

- c. Water Retention According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
 - d. Saturated Hydraulic Conductivity. According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods"; at 85% compaction according to ASTM D 698 (Standard Proctor).
- C. Chemical Testing:
- 1. CEC: Analysis by sodium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."
 - 2. Clay Mineralogy: Analysis and estimated percentage of expandable clay minerals using CEC by ammonium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 1- Physical and Mineralogical Methods."
 - 3. Phytotoxicity: Test for plant-available concentrations of phytotoxic minerals including aluminum, arsenic, barium, cadmium, chlorides, chromium, cobalt, copper, lead, lithium, mercury, nickel, selenium, silver, sodium, strontium, tin, titanium, vanadium, and zinc.
- D. Fertility Testing: Soil-fertility analysis according to standard laboratory protocol of SSSA NAPT NEC-67, including the following:
- 1. Percentage of organic matter.
 - 2. CEC, calcium percent of CEC, and magnesium percent of CEC.
 - 3. Soil reaction (acidity/alkalinity pH value).
 - 4. Buffered acidity or alkalinity.
 - 5. Nitrogen ppm.
 - 6. Phosphorous ppm.
 - 7. Potassium ppm.
 - 8. Manganese ppm.
 - 9. Manganese-availability ppm.
 - 10. Zinc ppm.
 - 11. Zinc availability ppm.
 - 12. Copper ppm.
 - 13. Sodium ppm and sodium absorption ratio.
 - 14. Soluble-salts ppm. 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.
 - 15. Other deleterious materials, including their characteristics and content of each.
- E. Organic-Matter Content: Analysis using loss-by-ignition method according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."
- F. Recommendations: Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants indicated. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients.
- 1. Fertilizers and Soil Amendment Rates: State recommendations in weight per 1000 sq. ft. for 6-inch depth of soil.
 - 2. Soil Reaction: State the recommended liming rates for raising pH or sulfur for lowering pH according to the buffered acidity or buffered alkalinity in weight per 1000 sq. ft. for 6-inch depth of soil.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Do not move or handle materials when they are wet or frozen.
4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Regional Materials: Imported soil and soil amendments and fertilizers shall be manufactured within **500 miles** of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles** of Project site.

2.2 PLANTING SOILS SPECIFIED BY COMPOSITION

- A. General: Soil amendments, fertilizers, and rates of application specified in this article are guidelines that may need revision based on testing laboratory's recommendations after preconstruction soil analyses are performed.
- B. Planting-Soil Type: Imported, naturally formed soil from off-site sources and consisting of sandy loam soil according to USDA textures; and modified to produce viable planting soil.
1. Sources: Take imported, unamended soil from sources that are naturally well-drained sites where topsoil occurs at least **4 inches** deep, not from agricultural land, bogs, or marshes; and that do not contain undesirable organisms; disease-causing plant pathogens; or obnoxious weeds and invasive plants including, but not limited to, quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and bromegrass.
 2. Additional Properties of Imported Soil before Amending: Soil reaction of pH 6 to 7 and minimum of 4 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.
 3. Unacceptable Properties: Clean soil of the following:
 - a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
 - b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 8 percent by dry weight of the imported soil.
 - c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding **2 inches** in any dimension.

- C. Planting-Soil Type Manufactured soil consisting of manufacturer's basic sandy loam according to USDA textures, blended in a manufacturing facility with sand, stabilized organic soil amendments, and other materials to produce viable planting soil.
 - 1. Additional Properties of Manufacturer's Basic Soil before Amending: Soil reaction of pH 6 to 7 and minimum of 6 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.
 - 2. Unacceptable Properties: Manufactured soil shall not contain the following:
 - a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
 - b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 5 percent by dry weight of the manufactured soil.
 - c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 1-1/2 inches in any dimension.

2.3 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
 - 1. Class: T, with a minimum of 99 percent passing through a No. 8 sieve and a minimum of 75 percent passing through a No. 60 sieve.
 - 2. Class: O, with a minimum of 95 percent passing through a No. 8 sieve and a minimum of 55 percent passing through a No. 60 sieve.
- B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a No. 6 sieve and a maximum of 10 percent passing through a No. 40 sieve.
- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- D. Perlite: Horticultural perlite, soil amendment grade.
- E. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through a No. 50 sieve.
- F. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to ASTM C 33/C 33M.

2.4 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. Compost: Compost shall have been composted in an in-vessel system, through a thermophilic stage, to a mesophilic stabilization phase. It shall have been aged for at least one year. The material shall be proven to be non-phytotoxic, and be screened to 1/2 inch.
 - a. Performance Criteria:
 - 1) Organic Matter: 60% or greater

- 2) pH: 5.0 – 8.0%
- 3) Ash Content: No more than 40%
- 4) Moisture Content: 35 – 55%
- 5) Soluble Salts: <6.0 mmhos/(dS)
- 6) C:N ratio: 15 to 30:1

- B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture with 100 percent passing through a **1/2-inch** sieve, a pH of 3.4 to 4.8, and a soluble-salt content measured by electrical conductivity of maximum 5 dS/m.
- C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture with 100 percent passing through a **1/2-inch** sieve, a pH of 6 to 7.5, a soluble-salt content measured by electrical conductivity of maximum 5 dS/m, having a water-absorbing capacity of 1100 to 2000 percent, and containing no sand.
- D. Wood Derivatives: Shredded and composted, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.
 1. Partially Decomposed Wood Derivatives: In lieu of shredded and composted wood derivatives, mix shredded and partially decomposed wood derivatives with ammonium nitrate at a minimum rate of **0.15 lb/cu. ft.** of loose sawdust or ground bark, or with ammonium sulfate at a minimum rate of **0.25 lb/cu. ft.** of loose sawdust or ground bark.
- 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.

2.5 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 testing agency.
- 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 testing agency.
- C. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

PART 3 - EXECUTION

3.1 GENERAL

- A. Place planting soil and fertilizers according to requirements in other Specification Sections.
- B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.
- C. Proceed with placement only after unsatisfactory conditions have been corrected.

3.2 PLACING AND MIXING PLANTING SOIL OVER EXPOSED SUBGRADE

- A. General: Apply and mix unamended soil with amendments on-site to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.
- B. Subgrade Preparation: Till subgrade to a minimum depth of **6 inches**. Remove stones larger than **1-1/2 inches** in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Apply, add soil amendments, and mix approximately half the thickness of unamended soil over prepared, loosened subgrade according to "Mixing" Paragraph below. Mix thoroughly into top **4 inches** of subgrade. Spread remainder of planting soil.
- C. Mixing: Spread unamended soil to total depth indicated on Drawings, but not less than required to meet finish grades after mixing with amendments and natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.
 - 1. Amendments: Apply soil amendments and fertilizer, if required, evenly on surface, and thoroughly blend them with unamended soil to produce planting soil.
 - a. Mix lime and sulfur with dry soil before mixing fertilizer.
 - b. Mix fertilizer with planting soil no more than seven days before planting.
- D. Compaction: Compact each blended lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698 and tested in-place.
- E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform the following tests:
 - 1. Compaction: Test planting-soil compaction after placing each lift and at completion using a densitometer or soil-compaction meter calibrated to a reference test value based on laboratory testing according to ASTM D 698. Space tests at no less than one for each **1000 sq. ft.** of in-place soil or part thereof.

- C. Right is reserved to take samples at any time of amended landscape soils and backfill mixes for testing for conformity to Specifications. Soil will be considered defective if it does not pass tests.
 - 1. Immediately remove and legal dispose rejected materials off site at Contractor's cost. Pay cost of testing of materials, not meeting Specifications.
- D. Prepare test reports.
- E. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.
- F. Contractor shall bear final responsibility for proper surface drainage of planted areas. discrepancy in the Drawings or Specifications, obstructions on the site, or prior work done by another party, which Contractor feels precludes establishing proper drainage shall be brought to the attention of Landscape Architect in writing for correction or relief of said responsibility.

3.4 PROTECTION

- A. Protection Zone: Identify protection zones according to Section 015639 "Temporary Tree and Plant Protection."
- B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Parking vehicles or equipment.
 - 3. Vehicle traffic.
 - 4. Foot traffic.
 - 5. Erection of sheds or structures.
 - 6. Impoundment of water.
 - 7. Excavation or other digging unless otherwise indicated.
- C. If planting soil or subgrade is overcompacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by Architect and replace contaminated planting soil with new planting soil.

3.5 CLEANING

- A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.
- B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.
 - 1. Dispose of excess subsoil and unsuitable materials on-site where directed by Owner.

END OF SECTION 329113

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. Sodding.
4. Meadow Grasses and wildflowers
5. Turf renovation.
6. 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.
2. [Section 328400 "Planting Irrigation" for irrigation.](#)

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 molluscicides. 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 329113 "Soil Preparation" 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: Five 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: Coordinate planting periods with initial maintenance periods to provide required maintenance from date of Substantial Completion.
- 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.
 - 1. Use seed materials, of the preferred species for local environmental and projected traffic conditions from certified sources.

2. Provide seed in containers clearly labeled to show seed name, lot number, net weight, percentage weed seed content, and guaranteed percentage of purity and germination. Pure Live Seed types and amount as indicated on Drawings

B. Seed Species:

1. Quality: State-certified seed of grass species as listed below for solar exposure.
2. Full Sun: Centipedegrass (*Eremochloa ophiuroides*).

2.2 TURFGRASS SOD

- A. Turfgrass Sod: Certified Number 1 Quality/Premium, including limitations on thatch, weeds, diseases, nematodes, and insects, 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.

1. Use a 1/4 inch shallow cut rolled sod from a reputable local grower.
2. Sod shall be grown in sand or sandy loam soils only. Sod grown in soils of clay, silt, or high organic materials such as peat, will not be accepted.

- B. Turfgrass Species: Centipedegrass (*Eremochloa ophiuroides*).

C. PROVIDE TURFGRASS SOD WITHOUT ANY MESH BACKING.

2.3 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.

2.4 MULCHES

- A. 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.
- B. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors

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 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 4-inch nominal mat thickness. Include manufacturer's recommended anchorage system for slope conditions.

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 Architect 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 329113 "Soil Preparation."

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 Architect'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 as recommended by seeding manufacturer.
- 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 1:6 with erosion-control fiber mesh installed and stapled according to manufacturer's written instructions.
- E. 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.
- F. Protect seeded areas from hot, dry weather or drying winds by applying peat mulch or planting soil within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of **3/16 inch**, and roll surface smooth.

3.6 HYDROSEEDING

- A. Hydroseeding: Mix specified seed, commercial 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. Following germination of the seed, areas lacking germination larger than **8 inches by 8 inches** must be reseeded.
4. Seeded areas must be fertilized and kept moist during development of the turf plants.

3.7 SODDING

- A. Lay sod within 24 hours of harvesting unless a suitable preservation method is accepted by Architect prior to delivery time. 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 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.
- D. Sodded areas must be fertilized and kept moist during root establishment (minimum of 3 weeks).

3.8 TURF RENOVATION

- A. Renovate existing turf where indicated.
- B. Renovate turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.
 1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
 2. Install new planting soil as required.

- C. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.
- D. Remove topsoil containing foreign materials, such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.
- E. Mow, dethatch, core aerate, and rake existing turf.
- F. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.
- G. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.
- H. Till stripped, bare, and compacted areas thoroughly to a soil depth of **6 inches**.
- I. Apply soil amendments and initial fertilizer required for establishing new turf and mix thoroughly into top **4 inches** of existing soil. Install new planting soil to fill low spots and meet finish grades.
 - 1. Soil Amendment(s): according to requirements of Section 329113 "Soil Preparation." Apply as required.
 - 2. Initial Fertilizer: Commercial fertilizer applied according to manufacturer's recommendations.
- J. Apply sod as required for new turf.
- K. Water newly planted areas and keep moist until new turf is established.

3.9 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 centipedegrass **1 to 2 inches**.
- D. Turf Postfertilization: Apply commercial 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.

3.10 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by Architect:
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.

3.11 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.

3.12 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.
- E. Repair any damage to adjacent materials and surfaces resulting from Cleanup and Protection work.

3.13 MAINTENANCE SERVICE

- A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Turf Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:
 - 1. Seeded Turf: 60 days from date of Substantial Completion.
 - a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.
 - 2. Sodded Turf: 60 days from date of Substantial Completion.

END OF SECTION 329200