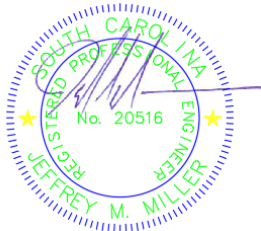


Horry County School

Riverside Elementary
New Parent Drop Off Loop
Little River, South Carolina



7-21-2021



Prepared by:
Mead & Hunt
333 Wellness Drive
Myrtle Beach, South Carolina

July 21, 2021

TABLE OF CONTENTS

<u>SECTION</u>	<u>TITLE</u>	<u>PAGE #</u>
	GEOTECHNICAL ENGINEERING REPORT	1-31
013000	ADMINISTRATIVE REQUIREMENTS	013000 1-2
013300	SUBMITTAL PROCEDURES	013300 1-6
014000	QUALITY REQUIREMENTS	014000 1-5
016000	PRODUCTS REQUIREMENTS	016000 1-2
2000	SITE CLEARING	2000 1-1
2100	EXCAVATION	2100 1-5
2200	BACKFILLING	2200 1-5
2300	TRENCHING	2300 1-4
2400	HOT MIX ASPHALT PAVEMENT	2400 1-5
2405	BASE COURSE MATERIAL STORM	2405 1-5
2500	DRAINAGE SYSTEMS	2500 1-6
2580	PAVEMENT MARKINGS	2580 1-2
3100	CONCRETE	3100 1-5
3150	CONCRETE CURB AND SIDEWALK	3150 1-3
3300	CONCRETE CURING	3300 1-2
024119	SELECTIVE DEMOLITION	024119 1-7
055213	PIPE AND TUBE RAILING	055213 1-12
323113	CHAIN LINK FENCES AND GATES	323113 1-10
328400	PLANTING IRRIGATION	328400 1-14
329113	SOIL PREPARATION	329113 1-9
329200	TURF AND GRASSES	329200 1-11

Riverside Elementary School
Civil Site Specifications



Geotechnical Engineering Report

**Riverside Elementary School
Little River, Horry County, South Carolina**

January 15, 2021

Terracon Project No. ER205021

Prepared for:

Mead & Hunt

Myrtle Beach, South Carolina

Prepared by:

Terracon Consultants, Inc.

Myrtle Beach, SC



January 15, 2021

Mead & Hunt
333 Wellness Drive
Myrtle Beach, South Carolina 29579



Attn: Mr. Jeffrey Miller, PE
E: jeff.miller@meadhunt.com

Re: Geotechnical Engineering Report
Riverside Elementary School
1283 Hwy 57 S
Little River, Horry County, South Carolina
Terracon Project No. ER205021

Dear Mr. Miller:

We have completed the Geotechnical Engineering services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. PER205021 dated November 10, 2020. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and pavement thickness for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.



Wendy H. Parsons, PE
Senior Engineer

Handwritten signature of Kevin Meeks in black ink.

Kevin Meeks
Field Engineer

Handwritten signature of Guoming Lin in black ink.

Guoming Lin, Ph.D., P.E.
Senior Principal

REPORT TOPICS

REPORT SUMMARY	I
INTRODUCTION.....	1
SITE CONDITIONS.....	1
PROJECT DESCRIPTION.....	2
GEOTECHNICAL CHARACTERIZATION.....	2
GEOTECHNICAL OVERVIEW	6
EARTHWORK.....	6
PAVEMENT RECOMMENDATIONS	9
GENERAL COMMENTS.....	12
ATTACHMENTS	14
EXPLORATION AND TESTING PROCEDURES	15
SITE LOCATION AND EXPLORATION PLANS	16
SITE LOCATION.....	17
EXPLORATION PLAN.....	18
EXPLORATION RESULTS.....	19

Note: This report was originally delivered in a web-based format. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES
SITE LOCATION AND EXPLORATION PLANS
EXPLORATION RESULTS
SUPPORTING INFORMATION

Note: Refer to each individual Attachment for a listing of contents.

REPORT SUMMARY

Topic ¹	Overview Statement ²
<p>Project Description</p>	<p>Based on information provided by the client, we understand that proposed improvements will consist of a two to three lane, approximately 2,300 lf parent loop. A portion of this loop, extending from the entrance at Hwy 57 to the traffic loop at approximately Sta 3+00, will experience bus traffic. The scope of this project is limited to the evaluation of new pavement areas.</p> <p>Final grades to match existing grades as much as possible (provided by client via email)</p> <p>Expected traffic for typical pavement areas:</p> <ul style="list-style-type: none"> ■ 2,000 to 2,500 cars and light truck traffic per day (assumed) ■ 2 Delivery trucks per day (assumed) <p>Additional expected traffic for heavy duty pavement areas:</p> <ul style="list-style-type: none"> ■ 20 bus trips per day (assumed)
<p>Geotechnical Characterization</p>	<p><u>Non-Paved Areas</u> Topsoil 6 inches Clayey sands to sandy clays to termination of deepest boring at 5 feet</p> <p><u>Paved Areas</u> Asphalt to approximately 1 ½ inches to 2 ½ inches Aggregate Base Course to approximately 9 inches to 16 inches Clayey/silty sands to sandy clays to termination of deepest boring at 5 feet Groundwater encountered at depths ranging from 2 ½ to 4 feet at locations HAB-1 and 2 at time of boring. Groundwater not encountered within exploration depths to 4 feet at other locations.</p>
<p>Earthwork</p>	<p>Undercut depths estimated 18 to 24 inches for unpaved areas. Proofroll and undercut as needed within pavement areas prior to new asphalt placement..</p>
<p>Existing Pavements</p>	<p>According to information provided by the client, we understand mill and overlay of the existing asphalt section is planned to take place. We have provided the following asphalt overlay thickness for light duty paved areas:</p> <ul style="list-style-type: none"> ■ Mill existing asphalt and overlay with 1.5 inches Asphaltic Concrete (AC) Surface Course Type C over 1.5 inches Asphaltic Concrete Intermediate Course Type C <p>We have provided the following asphalt overlay thickness for heavy duty/bus loop paved areas:</p> <ul style="list-style-type: none"> ■ Mill existing asphalt and overlay with 2.0 inches Asphaltic Concrete (AC) Surface Course Type C over 2.0 inches Asphaltic Concrete Intermediate Course Type C
<p>New Pavements</p>	<p>Asphalt (Non-Paved Areas, subgrade prepared as noted in Earthwork):</p> <ul style="list-style-type: none"> ■ 1.5 inches Asphaltic Concrete (AC) Surface Course Type C over 1.5 inches Asphaltic Concrete Intermediate Course Type C over 6 inches of Graded Aggregate Base Course (GABC) in Light Duty areas
<p>General Comments</p>	<p>This section contains important information about the limitations of this geotechnical engineering report.</p>

1. If the reader is reviewing this report as a pdf, the topics above can be used to access the appropriate section of the report by simply clicking on the topic itself.
2. This summary is for convenience only. It should be used in conjunction with the entire report for design purposes.

Geotechnical Engineering Report
Riverside Elementary School
1283 Hwy 57 S
Little River, Horry County, South Carolina
Terracon Project No. ER205021
January 15, 2021

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed parent loop at Lakewood Elementary to be located at 1283 Hwy 57 S in Little River, Horry County, South Carolina. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Site preparation and earthwork
- Subgrade preparation
- Pavement thickness recommendations
- Other geotechnical design parameters

Five Hand Auger Borings (HABs) with Dynamic Cone Penetrometer (DCP) testing were performed to depths of approximately 4 ½ to 5 feet below the existing ground surface. Three of the five HABs (HAB-1, HAB-2 and HAB-5) were advanced in the existing pavement section along the front of the school. HAB-2 was terminated short of the planned depth of 5 feet due to hole collapse at the time of boring.

Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs in the **Exploration Results** section.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The project is located at 1283 Hwy 57 S in Little River, Horry County, South Carolina. Latitude: 33.86354° Longitude: -78.72042° (See Exhibit D) See Site Location

Geotechnical Engineering Report

Riverside Elementary School ■ Little River, Horry County, South Carolina

January 15, 2021 ■ Terracon Project No. ER205021



Item	Description
Existing Improvements	Based on our recent site visit, the site is developed with existing building and parking areas.
Current Ground Cover	Based on our recent site visit, the site is cleared and contains a building, drives and parking areas.
Existing Topography	Topographic information was not available at the time this report was prepared. Based on our recent site visit, the site appears relatively flat within the roadway alignment.

PROJECT DESCRIPTION

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Proposed Improvements	Based on information provided by the client, we understand that proposed improvements will consist of a parent loop approximately 2300 feet in length. A portion of this loop, extending from the entrance at Hwy 57 to the traffic loop at approximately Sta 3+00, will experience bus traffic. The proposed loop consists of both new and existing pavements.
Grading	A grading plan has not been provided during the course of our work. Based on communications with the client, we understand that final grades are expected to match existing grades as much as possible. If final grading plans differ from what has been assumed, a review must be made by Terracon to determine if modifications to our design will be required.
Pavements	We assume flexible (asphalt) pavement sections should be considered. Anticipated traffic is as follows: <ul style="list-style-type: none">■ 2,000 to 2,500 cars and light truck traffic per day (assumed)■ 2 Delivery trucks per week (assumed) Additional expected traffic for heavy duty pavement areas: <ul style="list-style-type: none">■ 20 bus trips per day (assumed) Pavement design period is 20 years.

GEOTECHNICAL CHARACTERIZATION

Subsurface Profile

Based on the results of the field exploration, subsurface conditions on the project site can be generalized as follows:

Geotechnical Engineering Report

Riverside Elementary School ■ Little River, Horry County, South Carolina

January 15, 2021 ■ Terracon Project No. ER205021



Non-Paved Areas

Description	Approximate Depth to Bottom of Stratum	Material Encountered ¹
Stratum 1	6 to 12 inches	Topsoil
Stratum 2	5 feet ²	Very loose to medium dense Clayey Sands (SC) to medium stiff to stiff Sandy Clays (CL)

1. Material descriptions are based on visual classification from HAB samples and correlations with in situ data.
2. Termination of deepest boring.

Existing Pavement Conditions

Based on the results of the field exploration, subsurface conditions on the project site for the paved areas evaluated can be generalized as follows:

Location	Average Asphalt Thickness (in)	Average Base Course Thickness (in)	Subgrade Description
HAB-1	2.5	13.5	Medium stiff sandy clay (CL) to loose to medium dense clayey sand (SC)
HAB-2	2.0	11.0	Very loose to medium dense silty sand (SM) to 3 ½ feet, underlain by medium dense clayey sand (SC)
HAB-5	1.5	7.5	Medium dense silty sand (SM) to 1 ½ feet, underlain by soft sandy clay (CL) to very loose clayey sand (SC)

In addition to the subsurface investigation, we performed a limited visual condition survey of the existing pavement. Our visual inspection of pavements indicated the existing pavements are in fair condition overall. Low severity edge, longitudinal and block cracking along with medium severity rutting was observed in the vicinity of test location HAB-1/bus loop area of the site. Low to medium severity block and alligator cracking was observed in the existing parking areas. Examples are depicted in the following pictures from the site:

Geotechnical Engineering Report

Riverside Elementary School ■ Little River, Horry County, South Carolina

January 15, 2021 ■ Terracon Project No. ER205021



Image 1 - Low Sev. Block Cracking



Image 2 – Low to Medium Sev. Block Cracking



Image 3 - Good to fair pavement conditions



Image 4 - Fair Pavement Conditions



Image 5 – Good to Fair pavement conditions



Image 6 - Low Sev. Edge Cracking

Geotechnical Engineering Report

Riverside Elementary School ■ Little River, Horry County, South Carolina
January 15, 2021 ■ Terracon Project No. ER205021



Image 7 - Low Sev. Alligator Cracking



Image 8 - Med. Sev. Alligator Cracking



Image 9 - Med. Sev. Rutting



Image 10 - Low Sev. Longitudinal Cracking

Conditions encountered at each test location are indicated on the individual test records. Stratification boundaries on the test records represent the approximate location of changes in soil types. The transition between materials may be gradual. Details for each of the tests can be found in [Exploration Results](#).

Groundwater Conditions

The near surface soils at the site generally consisted of clayey sands to sandy clays (SC/CL) to depths of approximately 5 feet below the existing ground surface, which contain an elevated fines content. These soils tend to drain poorly during and after periods of heavy rainfall, resulting in perched groundwater conditions as water collects above these low permeability soils. During periods of heavy rainfall, water will move laterally across the site and collect in low-lying areas before slowly infiltrating into the true groundwater table.

The following table lists approximate depths to groundwater encountered below existing grade at the time of our field exploration.

Geotechnical Engineering Report

Riverside Elementary School ■ Little River, Horry County, South Carolina

January 15, 2021 ■ Terracon Project No. ER205021



Location	Groundwater Depth (ft)
HAB-1	4
HAB-2	2 ½
HAB-3	N/E
HAB-4	N/E
HAB-5	N/E

1. N/E – Not encountered up to boring termination

Groundwater levels were measured by physical observation within hand auger borings. Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project. The groundwater surface should be checked prior to construction to assess its effect on site work and other construction activities.

GEOTECHNICAL OVERVIEW

The near-surface soils within unpaved areas of the site generally consisted of clayey sands to sandy clays (SC/CL) to a depth of approximately 5 feet below the existing ground surface, which contain an elevated fines content. While stable in a dry condition, these clayey soils will deteriorate rapidly when exposed to excess moisture. Due to the moisture sensitivity of in-situ soils, it is our opinion that subgrade stabilization will be required depending on final roadway grading plans. Undercutting recommendations have been provided for these soils. The extent of the undercutting will be dependent on moisture conditions at the time of construction including weather conditions and the effectiveness of site drainage in place at the time earthwork is in progress. Effective drainage should be completed early in the construction sequence and maintained after construction to minimize potential issues. If possible, the grading should be performed during the warmer and drier times of the year. If grading is performed during the winter months, an increased risk for possible undercutting and replacement of unstable subgrade will persist. Additional site preparation recommendations, including subgrade improvement and fill placement, are provided in the **Earthwork** section.

The **General Comments** section provides an understanding of the report limitations.

EARTHWORK

Earthwork is anticipated to include clearing, stripping, grubbing, subgrade remediation and fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for pavements.

Site Preparation

Positive site drainage should be established prior to the start of earthwork activities. This is especially important due to the presence of near surface clayey sands encountered across a majority of the site. These soils are moisture sensitive and exposure to water and construction traffic can lead to softening and rutting of the upper material. Therefore, we recommend that a site drainage plan be established and implemented prior to large scale clearing/stripping activities. This can include directing runoff water to existing drainage features, excavation of temporary sumps, drainage ditches, and/or swales across the project site. These measures will allow for perched water to be directed away from construction areas limiting the softening of near surface soils. A grading plan was not available at the time of this report.

With positive drainage established, the proposed limits of construction should be stripped of trees, organic material, topsoil, root balls, and other deleterious material from within the proposed roadway alignment. Stripping should extend a minimum of 5 feet outside the construction area footprint. We anticipate stripping depths to average 6 to 12 inches across the site. **Please bear in mind**, due to the uneven ground surface of the site, the volume of topsoil and organics may be significantly greater than the area times the topsoil/organics thickness indicated in the boring logs. Rutting of the subgrade can also cause mixing of topsoil/organics with underlying soils, which will result in additional required topsoil/organics stripping. Deeper undercut may be needed in some localized areas to remove tree stumps or other unsuitable materials, especially in wetland areas. Voids remaining from the clearing/stripping operation should be backfilled with properly compacted Controlled Fill.

After stripping and subgrade repair is completed, the existing subgrade should be proofrolled with a loaded tandem axle dump truck or other similar approved construction equipment. A geotechnical engineer should monitor proofrolling operations. Areas that pump or rut excessively should be undercut and reworked or replaced with Controlled Fill. Excessively wet or dry material should either be removed or moisture conditioned and recompacted.

The near surface soils within unpaved areas of the site generally consisted of clayey sands to sandy clays (SC to CL), which contain an elevated fines content. While stable in a dry condition, these clayey soils will deteriorate rapidly when exposed to excess moisture. Due to the moisture sensitivity of in-situ soils, it is our opinion that stabilization within the new pavement areas will be required. Stabilization efforts within proposed pavement areas can consist of undercutting to a stable material and backfilling with Controlled Fill. We have estimated undercut depths within the paved areas of approximately 18 to 24 inches. At a minimum, undercut depths should allow for 18 inches of Controlled Fill between the existing subgrade and Graded Aggregate Base Course (GABC). Any Controlled Fill already required to elevate the parking areas to finished subgrade elevation can be included in this 18 inches provided the condition of the existing subgrade is inspected and approved by the geotechnical engineer prior to fill placement. Undercutting may be deeper in isolated areas depending on soil conditions encountered. Undercutting should extend a minimum of 1 foot outside the pavement area. Undercut soils should be replaced with Controlled

Geotechnical Engineering Report

Riverside Elementary School ■ Little River, Horry County, South Carolina
January 15, 2021 ■ Terracon Project No. ER205021



Fill as outlined below. The extent of the stabilization will be dependent on weather conditions and the effectiveness of site drainage in place at the time earthwork is in progress. Undercut soils could be utilized as non-structural fill in landscaped and grassed areas.

If near surface soils are exposed to rubber-tired traffic during wet periods, they may lose their strength leading to rutting and increased undercutting depths. The ability to maintain competent bearing soils will affect pavement design and overall performance. Placement of base course materials as soon as possible in pavement areas would provide protection for the subgrade as other construction takes place. Clearing techniques that minimize soil subgrade disturbance should be employed.

Soil conditions indicate underdrains will be required to adequately drain the roadway subgrades within the area of undercutting. The undercut subgrade should be graded to match final grading plans prior to placement of Controlled Fill to promote drainage to low areas where the underdrains will be located. After underdrain placement, Controlled Fill can be placed as required. In short, underdrain placement can proceed along with the overexcavation and replacement process. The configuration of underdrains would be dependent upon the project grading and drainage plans which can be reviewed to finalize underdrain placement. The underdrain plan should be coordinated with the site civil design engineer. Terracon can provide additional design criteria and input for underdrains as required.

All subgrade and base course materials and placement procedures should adhere to the SCDOT Standard Specifications for Highway Construction, 2007 Edition.

Fill Material Types

Fill required to achieve design grade should be classified as structural fill and general fill. Structural fill is material used below, or within 10 feet of structures, pavements or constructed slopes. General fill is material used to achieve grade outside of these areas. Earthen materials used for structural and general fill should meet the following material property requirements:

Soil Type ¹	USCS Classification	Acceptable Parameters (for Structural Fill)
Controlled, Imported Fill	SP, SP-SM, SP-SW, SW, SM	Non-plastic Less than 12% passing No. 200 sieve

1. Structural and general fill should consist of approved materials free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation prior to use on this site.

Fill Compaction Requirements

ITEM	DESCRIPTION
Fill Lift Thickness	When heavy, self-propelled compaction equipment is used, fill lifts shall have a maximum of 8 inches in loose thickness.
	When hand-guided equipment (i.e. jumping jack or plate compactor) is used, fill lifts shall have a maximum of 2 to 4 inches in loose thickness.
Compaction Requirements ¹	The pavement base course should be compacted to 100% of the material's maximum Modified Proctor dry density (ASTM D1557).
	The upper 12 inches of the pavement subgrade should be compacted to 95% of the material's maximum Modified Proctor dry density (ASTM D1557).
Moisture Content – Controlled Fill or Onsite Soils ²	Within the range of ±2% of optimum moisture content value as determined by the Modified Proctor test.

1. Fill should be tested for moisture content and compaction during placement. If the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.

2. Specifically, moisture levels should be maintained low enough to allow for satisfactory compaction to be achieved without the Controlled Fill material pumping when proofrolled.

PAVEMENT RECOMMENDATIONS

Existing Paved Areas

It is our understanding milling and overlay is planned for rehabilitation of the existing pavement. We recommend milling the existing asphalt and replacing with 1 ½ inches of asphalt concrete intermediate course Type C followed by 1 ½ inches of asphalt concrete surface course Type C in light duty areas and 2 inches of asphalt concrete intermediate course Type C followed by 2 inches of asphalt concrete surface course Type C in heavy duty/bus loop areas. The extent of milling required will be dependent on the final grading plan.

For existing paved areas, it appears the existing subgrade and base courses are adequate at location HAB-2 and marginal at locations HAB-1 and 3. For example, HAB-1 is located within the bus loop and subsurface conditions consisted of 2 ½ inches of asphalt and 13 ½ of base course underlain by in-situ clayey sand/sandy clay soils. Once areas such as HAB-1 and 3 are milled to prepare for placement of new asphalt, approximately 13 to 15 inches of suitable base/subgrade material will remain in place to “bridge” existing clayey soils. Construction traffic should be limited as much as possible on these exposed soils and positive drainage should be maintained at all

times to limit potential instability and subsequent undercutting of these areas prior to placement of the new asphalt course. Subgrade repair/undercutting may be required in areas of more severe pavement distress such as that depicted in the area of the existing bus loop shown in Image 9 of the report section entitled **Existing Pavement Conditions**. This level of distress appeared isolated and was limited to the intersection of the bus loop and entrance drive at the time of our pavement inspection.

Disturbance to the existing base course material should be minimized as much as possible in order to maintain the existing thickness after milling operations. After milling operations take place, preparation of the base course should adhere to the SCDOT Standard Specifications for Highway Construction, 2007 Edition.

Construction traffic and additional wear and tear may deteriorate pavements further prior to time of paving. Construction traffic should be kept at a minimum on existing pavement. We recommend any milled surface not be exposed and subject to heavy or continual traffic for an extended period of time.

Subgrade Preparation – Unpaved Areas

Pavement subgrades should be carefully evaluated by Terracon personnel as the time for pavement construction approaches. The moisture content and density of the subgrade should be evaluated and the pavement subgrades proofrolled prior to commencement of actual paving operations. Areas not in compliance with the required ranges of moisture or density should be moisture conditioned and recompacted (or removed and replaced). Particular attention should be paid to high traffic areas that were rutted and disturbed during earlier construction activities and to areas where backfilled trenches are located.

If a significant precipitation event occurs after the evaluation or if the surface becomes disturbed, the subgrade should be reviewed by qualified personnel immediately prior to paving. The subgrade should be in its finished form at the time of the final review.

Estimates of Minimum Pavement Thickness

Anticipated traffic loading conditions were not available at the time this report was prepared; however, based on the anticipated use of the development, we have provided minimum pavement thickness for “light duty” and “heavy duty” traffic areas. “Light duty” pavement is used in parking/drive areas subjected solely to light passenger car and light truck traffic. “Heavy duty” traffic should be used for the main drive lanes/bus loop areas. Rigid pavement is recommended to be used for trash container pads and areas subjected to heavy wheel loads and/or turning traffic.

Pavement sections were evaluated using the American Association of State Highway and Transportation Official’s (AASHTO) “Structural Number” (S_N) system. For pavement design, the

Geotechnical Engineering Report

Riverside Elementary School ■ Little River, Horry County, South Carolina
January 15, 2021 ■ Terracon Project No. ER205021



AASHTO system converts an estimated Average Daily Traffic (ADT) or Vehicles per Day (VPD) to an Equivalent 18 kip Single Axle Loads (ESAL's) placed on the pavement during its design life. In our analysis, light duty pavements are estimated to be subjected to a traffic load on the order of 100,000 ESAL's whereas heavy duty pavements will be subjected to a loading on the order of 250,000 ESAL's.

For new flexible pavements, the minimum S_N required by the traffic loading and the subgrade soil strength is calculated from the subgrade strength data, assumed traffic volumes, assumed traffic growth rate, and design life. Based on the implementation of site preparation previously outlined in this report, we have assumed a CBR value of 8. The following tables provides our recommendations for flexible pavements. Terracon should be contacted to review and revise these recommendations if traffic loading significantly differs from those assumed herein.

Paved Areas

Traffic Area	Rehabilitation Option	Existing Pavement Milling Depth (in)	A/C Surface Course Overlay (in) (SCDOT Type C)	A/C Intermediate Course Overlay (in) (SCDOT Type C)
Existing Pavement-Light Duty	Mill and A/C Overlay	Dependent on Final Grades	1.5	1.5
Existing Pavement-Heavy Duty (bus loop)	Mill and A/C Overlay	Dependent on Final Grades	2.0	2.0

Non-Paved Areas

Proposed Roadway	Aggregate Base (SCDOT GABC)	A/C Surface (SCDOT Type C)	A/C Intermediate (SCDOT Type C)	Total Thickness
Light Duty	6	1.5	1.5	9

Subgrade, base and pavement construction operations and materials should meet the minimum requirements of the South Carolina Department of Transportation's (SCDOT) *Standard Specifications for Highway Construction*, 2007 edition. The Aggregate Base Course should be compacted to 100% of its Modified Proctor as determined by AASHTO T-150. The Asphalt Concrete should be compacted to 92.2% to 95% of the theoretical specific gravity of the mix, as determined by ASTM D2041.

Pavement Drainage

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration. In addition, the pavement subgrade should be graded to provide positive drainage within the granular base section. Appropriate sub-drainage or connection to a suitable daylight outlet should be provided to remove water from the granular subbase.

Openings in pavements, such as decorative landscaped areas, are sources for water infiltration into surrounding pavement systems. Water can collect in the islands and migrate into the surrounding subgrade soils thereby degrading support of the pavement. This is especially applicable for islands with raised concrete curbs, irrigated foliage, and low permeability near-surface soils. The civil design for the pavements with these conditions should include features to restrict or collect and discharge excess water from the islands. Examples of features are edge drains connected to the storm water collection system, longitudinal subdrains, or other suitable outlets and impermeable barriers preventing lateral migration of water such as a cutoff wall installed to a depth below the pavement structure.

Pavement Maintenance

The pavement sections represent minimum recommended thicknesses and, as such, periodic maintenance should be anticipated. Therefore, preventive maintenance should be planned and provided for through an on-going pavement management program. Maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Maintenance consists of both localized maintenance (e.g., crack and joint sealing and patching) and global maintenance (e.g., surface sealing). Preventive maintenance is usually the priority when implementing a pavement maintenance program. Additional engineering observation is recommended to determine the type and extent of a cost-effective program. Even with periodic maintenance, some movements and related cracking may still occur and repairs may be required.

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is

Geotechnical Engineering Report

Riverside Elementary School ■ Little River, Horry County, South Carolina
January 15, 2021 ■ Terracon Project No. ER205021



solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

ATTACHMENTS

Geotechnical Engineering Report

Riverside Elementary School ■ Little River, Horry County, South Carolina
January 15, 2021 ■ Terracon Project No. ER205021



EXPLORATION AND TESTING PROCEDURES

Field Exploration

Type of Test	Number of Borings	Boring Depth (feet)	Planned Location
Hand Auger Borings (HABs)	3	4 ½ to 5 feet	Existing Pavement
Hand Auger Borings (HABs)	2	5 feet	Proposed Drive Areas

Boring Layout and Elevations: Unless otherwise noted, Terracon personnel provided the boring layout. The test locations were located in the field by Terracon personnel utilizing a commercially available handheld Global Position System (GPS) unit which are typically considered accurate to within ±20 feet. The locations should be considered accurate only to the degree implied by the means and methods used to define them. If elevations and a more precise boring layout are desired, we recommend borings be surveyed following completion of fieldwork.

The field exploration was performed on December 18th, 2020.

Subsurface Exploration Procedures:

Hand Auger Borings

Hand auger borings were conducted in general accordance with ASTM D 1452-80, Standard Practice for Soil Investigation and Sampling by Auger Borings. In this test, hand auger borings are drilled by rotating and advancing a bucket auger to the desired depths while periodically removing the auger from the hole to clear and examine the auger cuttings. The soils were classified in accordance with ASTM D 2488.

SITE LOCATION AND EXPLORATION PLANS

Contents:

Site Location Plan

Exploration Plan

Note: All attachments are one page unless noted above.

SITE LOCATION

Riverside Elementary School ■ Little River, Horry County, South Carolina
January 15, 2021 ■ Terracon Project No. ER205021

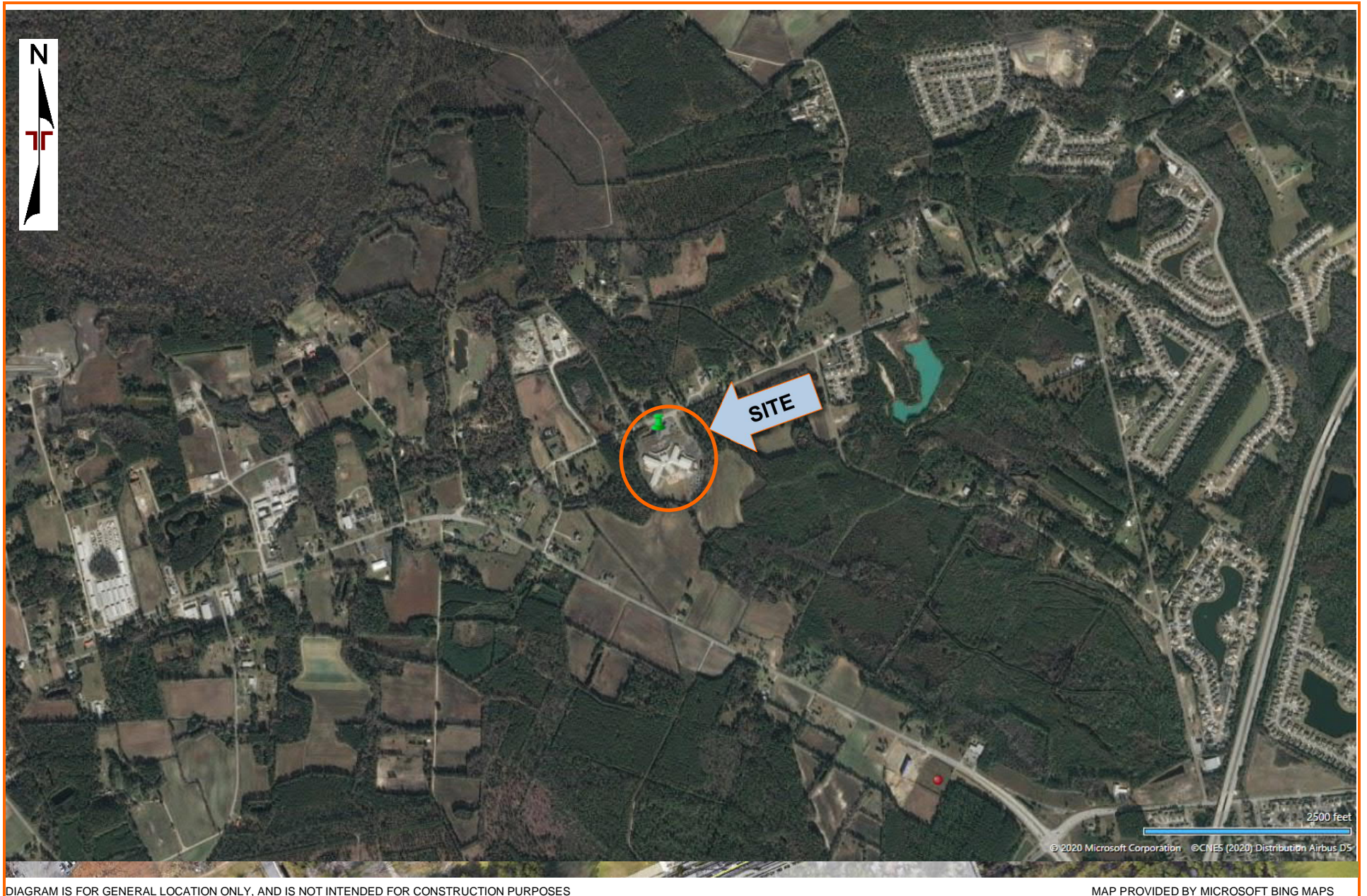


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN

Riverside Elementary School ■ Little River, Horry County, South Carolina
January 15, 2021 ■ Terracon Project No. ER205021

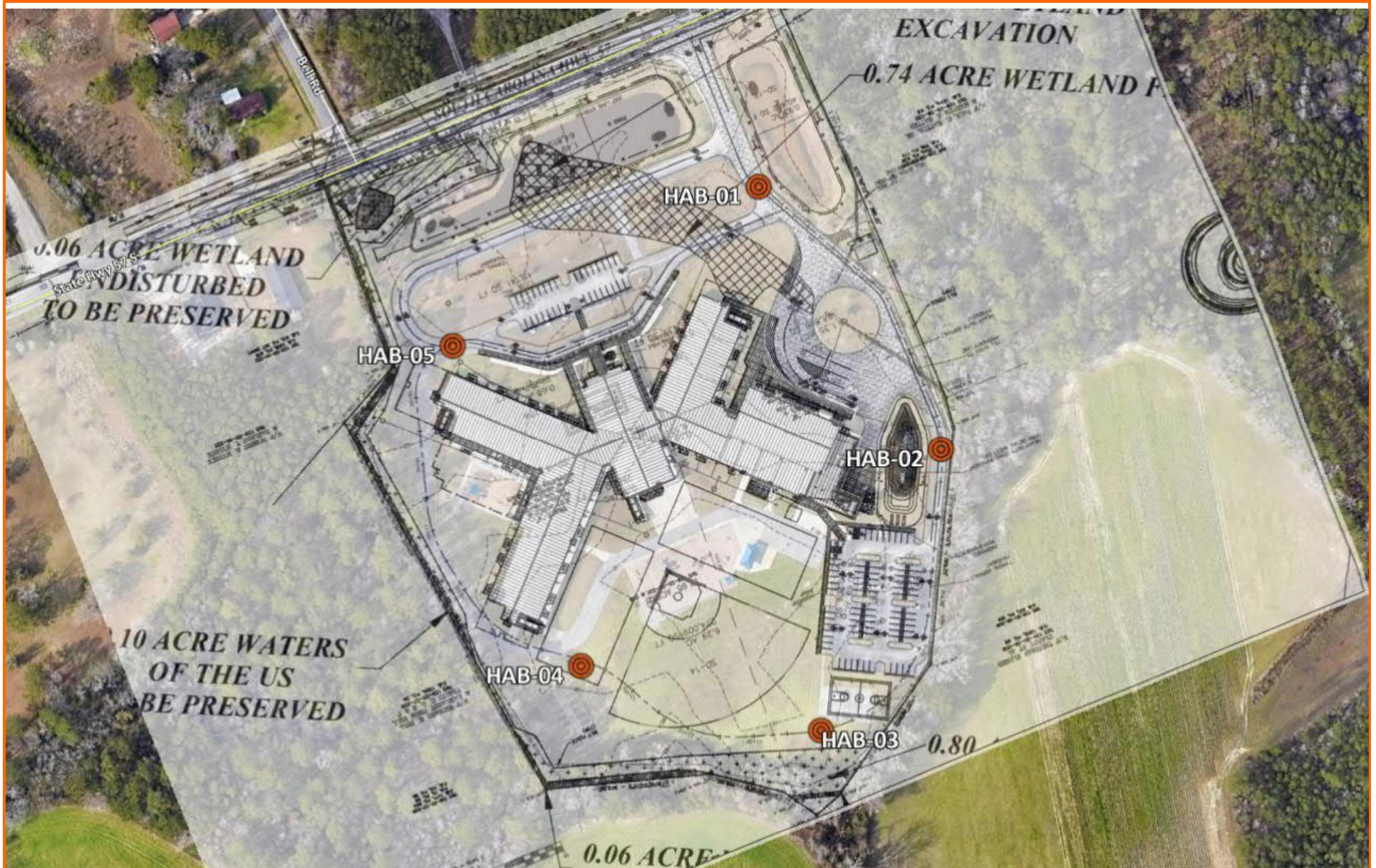


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION RESULTS

Contents:

Hand Auger Boring Logs (HAB-1 through HAB-5)

Note: All attachments are one page unless noted above.

BORING LOG NO. HAB-1

PROJECT: Riverside Elementary School Dropoff Loop

CLIENT: Mead & Hunt, Inc.
Myrtle Beach, SC

SITE: 1283 Hwy 57 S
Little River, SC

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL ER205021 RIVERSIDE ELEMENT.GPJ TERRACON DATATEMPLATE.GDT 1/5/21

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 33.8645° Longitude: -78.7198°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS
	DEPTH				
0.2	ASPHALT , approximately 2.5" thick				
1.3	AGGREGATE BASE COURSE , approximately 13.5" thick				
3.0	SANDY LEAN CLAY/CLAYEY SAND (CL/SC) , gray and red, medium stiff, loose, (50%)		↓		4 - 5 - 7
5.0	CLAYEY SAND (SC) , red, medium dense, (30%)		↓		6 - 6 - 8
5.0	Boring Terminated at 5 Feet	5	↓		9 - 14 - 15
			▽		13 - 15
			↓		9 - 15

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Manual Hand Auger

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (if any).

Notes:

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

WATER LEVEL OBSERVATIONS
▽ Estimated 4 feet at Time of Boring



Boring Started: 12-18-2021

Boring Completed: 12-18-2021

Drill Rig:

Driller: CW

Project No.: ER205021

BORING LOG NO. HAB-2

PROJECT: Riverside Elementary School Dropoff Loop

CLIENT: Mead & Hunt, Inc.
Myrtle Beach, SC

SITE: 1283 Hwy 57 S
Little River, SC

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL ER205021 RIVERSIDE ELEMENT.GPJ TERRACON DATATEMPLATE.GDT 1/5/21

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 33.8635° Longitude: -78.7189°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS
	DEPTH				
0.2	ASPHALT , approximately 2.0" thick				
1.1	AGGREGATE BASE COURSE , approximately 11.0" thick				
1.1	SILTY SAND (SM) , gray and red, very loose to medium dense, (15%)		↓		10 - 15
3.5	CLAYEY SAND (SC) , red, medium dense, (35%)		↓		10 - 15
4.5	Boring Terminated at 4.5 Feet due to Hole Collapse		↓		5 - 6 - 3
4.5			↓		9 - 12 - 13
4.5			↓		15

Stratification lines are approximate. In-situ, the transition may be gradual.



Advancement Method: Manual Hand Auger	See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any). See Supporting Information for explanation of symbols and abbreviations.	Notes:
Abandonment Method: Boring backfilled with auger cuttings upon completion.		
WATER LEVEL OBSERVATIONS		
▽ Estimated 2.5 feet at Time of Boring		
Cave-in estimated 4.5 feet at Time of Boring		
Terracon 1246 Howard Ave Myrtle Beach, SC		Boring Started: 12-18-2021 Boring Completed: 12-18-2021
		Drill Rig: CW Project No.: ER205021

BORING LOG NO. HAB-3

PROJECT: Riverside Elementary School Dropoff Loop

CLIENT: Mead & Hunt, Inc.
Myrtle Beach, SC

SITE: 1283 Hwy 57 S
Little River, SC

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 33.8623° Longitude: -78.7195°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS
DEPTH					
	TOPSOIL				
0.5					
	CLAYEY SAND (SC) , tan, gray and orange, medium dense, (25-35%)		↓		12 - 15
			↓		8 - 11 - 13
			↓		9 - 12 - 13
			↓		10 - 11 - 14
5.0		5	↓		12 - 13 - 12
	Boring Terminated at 5 Feet				

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Manual Hand Auger

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (if any).

Notes:

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

WATER LEVEL OBSERVATIONS

Not encountered at Time of Boring



Boring Started: 12-18-2021

Boring Completed: 12-18-2021

Drill Rig:

Driller: CW

Project No.: ER205021


THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL ER205021 RIVERSIDE ELEMENT.GPJ TERRACON DATATEMPLATE.GDT 1/5/21

BORING LOG NO. HAB-4

PROJECT: Riverside Elementary School Dropoff Loop

CLIENT: Mead & Hunt, Inc.
Myrtle Beach, SC

SITE: 1283 Hwy 57 S
Little River, SC

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 33.8626° Longitude: -78.7207°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS
DEPTH					
	TOPSOIL				
0.5	SANDY LEAN CLAY/CLAYEY SAND (CL/SC) , orange and red, medium stiff to stiff, loose, (50%)		↓		7 - 8 - 9
3.5	CLAYEY SAND (SC) , gray, orange and red, loose, (35%)		↓		8 - 9 - 11
5.0	Boring Terminated at 5 Feet	5	↓		7 - 8 - 10
			↓		9 - 9 - 11
			↓		8 - 9 - 8

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Manual Hand Auger

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

WATER LEVEL OBSERVATIONS

Not encountered at Time of Boring



Boring Started: 12-18-2021

Boring Completed: 12-18-2021

Drill Rig:

Driller: CW

Project No.: ER205021

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL_ER205021 RIVERSIDE ELEMENT.GPJ TERRACON DATATEMPLATE.GDT 1/5/21

BORING LOG NO. HAB-5

PROJECT: Riverside Elementary School Dropoff Loop

CLIENT: Mead & Hunt, Inc.
Myrtle Beach, SC

SITE: 1283 Hwy 57 S
Little River, SC

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL ER205021 RIVERSIDE ELEMENT.GPJ TERRACON DATATEMPLATE.GDT 1/5/21

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 33.8639° Longitude: -78.7213°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS
	DEPTH				
0.1	ASPHALT , approximately 1.5" thick				
	AGGREGATE BASE COURSE , approximately 7.5" thick				
0.8	SILTY SAND (SM) , dark gray, medium dense, (30%)		↓		15
1.5	SANDY LEAN CLAY/CLAYEY SAND (CL/SC) , dark gray, soft, very loose, (50%)		↓		11 - 5 - 4
3.5	CLAYEY SAND (SC) , dark gray, very loose, (35%)		↓		4 - 4 - 5
5.0	Boring Terminated at 5 Feet	5	↓		4 - 4 - 4
			↓		3 - 2 - 3

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Manual Hand Auger

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

WATER LEVEL OBSERVATIONS

Not encountered at Time of Boring



Boring Started: 12-18-2021

Boring Completed: 12-18-2021

Drill Rig:

Driller: CW

Project No.: ER205021

SUPPORTING INFORMATION

Contents:

Unified Soil Classification System
General Notes

Note: All attachments are one page unless noted above.

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A				Soil Classification		
				Group Symbol	Group Name ^B	
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	Gravels: More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels: Less than 5% fines ^C	$Cu \geq 4$ and $1 \leq Cc \leq 3$ ^E	GW	Well-graded gravel ^F	
			$Cu < 4$ and/or $[Cc < 1$ or $Cc > 3.0]$ ^E	GP	Poorly graded gravel ^F	
		Gravels with Fines: More than 12% fines ^C	Fines classify as ML or MH	GM	Silty gravel ^{F, G, H}	
			Fines classify as CL or CH	GC	Clayey gravel ^{F, G, H}	
	Sands: 50% or more of coarse fraction passes No. 4 sieve	Clean Sands: Less than 5% fines ^D	$Cu \geq 6$ and $1 \leq Cc \leq 3$ ^E	SW	Well-graded sand ^I	
			$Cu < 6$ and/or $[Cc < 1$ or $Cc > 3.0]$ ^E	SP	Poorly graded sand ^I	
		Sands with Fines: More than 12% fines ^D	Fines classify as ML or MH	SM	Silty sand ^{G, H, I}	
			Fines classify as CL or CH	SC	Clayey sand ^{G, H, I}	
Fine-Grained Soils: 50% or more passes the No. 200 sieve	Silts and Clays: Liquid limit less than 50	Inorganic:	$PI > 7$ and plots on or above "A" line	CL	Lean clay ^{K, L, M}	
			$PI < 4$ or plots below "A" line ^J	ML	Silt ^{K, L, M}	
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay ^{K, L, M, N}
			Liquid limit - not dried			Organic silt ^{K, L, M, O}
	Silts and Clays: Liquid limit 50 or more	Inorganic:	PI plots on or above "A" line	CH	Fat clay ^{K, L, M}	
			PI plots below "A" line	MH	Elastic Silt ^{K, L, M}	
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay ^{K, L, M, P}
			Liquid limit - not dried			Organic silt ^{K, L, M, Q}
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat	

^A Based on the material passing the 3-inch (75-mm) sieve.

^B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

^C Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

^D Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

$$E \quad Cu = D_{60}/D_{10} \quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

^F If soil contains $\geq 15\%$ sand, add "with sand" to group name.

^G If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

^H If fines are organic, add "with organic fines" to group name.

^I If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.

^J If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

^K If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

^L If soil contains $\geq 30\%$ plus No. 200 predominantly sand, add "sandy" to group name.

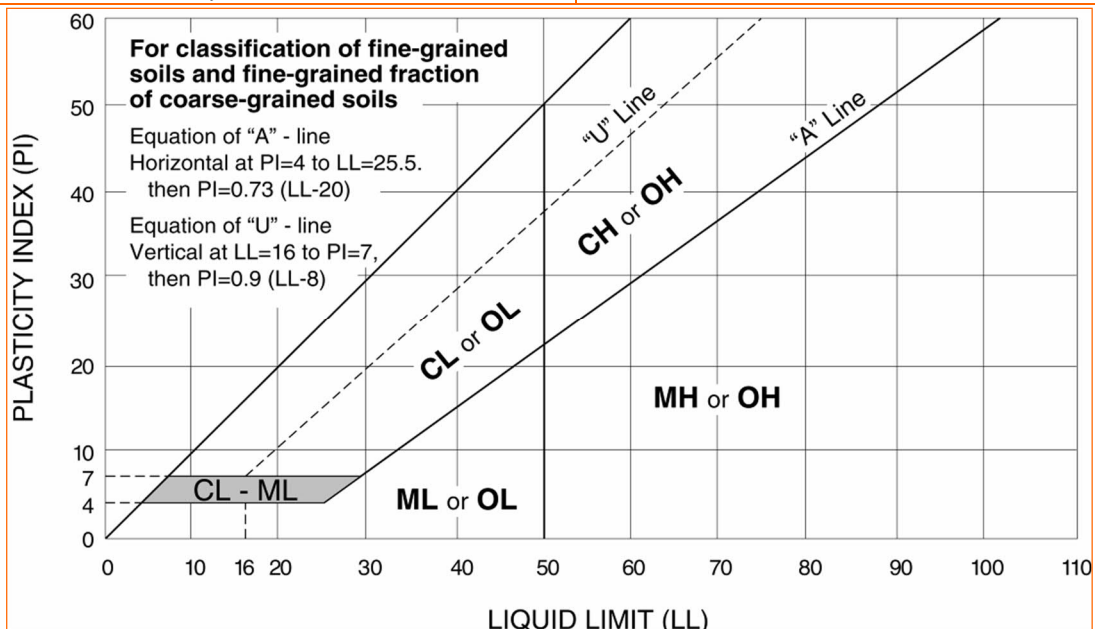
^M If soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.

^N $PI \geq 4$ and plots on or above "A" line.

^O $PI < 4$ or plots below "A" line.












^P PI plots on or above "A" line.

^Q PI plots below "A" line.



GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING			WATER LEVEL		Water Initially Encountered	FIELD TESTS	(HP) Hand Penetrometer
	Auger	Split Spoon			Water Level After a Specified Period of Time		(T) Torvane
					Water Level After a Specified Period of Time		(b/f) Standard Penetration Test (blows per foot)
	Shelby Tube	Macro Core		Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.			(PID) Photo-Ionization Detector
							(OVA) Organic Vapor Analyzer
Ring Sampler	Rock Core						
							
Grab Sample	No Recovery						

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS	RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance Includes gravels, sands and silts.			CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
	Descriptive Term (Density)	Standard Penetration or N-Value Blows/Ft.	Ring Sampler Blows/Ft.	Descriptive Term (Consistency)	Unconfined Compressive Strength, Qu, tsf	Standard Penetration or N-Value Blows/Ft.
Very Loose	0 - 3	0 - 6	Very Soft	less than 0.25	0 - 1	< 3
Loose	4 - 9	7 - 18	Soft	0.25 to 0.50	2 - 4	3 - 4
Medium Dense	10 - 29	19 - 58	Medium-Stiff	0.50 to 1.00	4 - 8	5 - 9
Dense	30 - 50	59 - 98	Stiff	1.00 to 2.00	8 - 15	10 - 18
Very Dense	> 50	≥ 99	Very Stiff	2.00 to 4.00	15 - 30	19 - 42
			Hard	> 4.00	> 30	> 42

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 sieve (0.075mm)

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

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
RIVERSIDE ELEM. NEW PARENT LOOP
LITTLE RIVER, SOUTH CAROLINA

MEAD & HUNT, INC.
PROJECT NO. 2122-7MJ 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.

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.Contractors 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

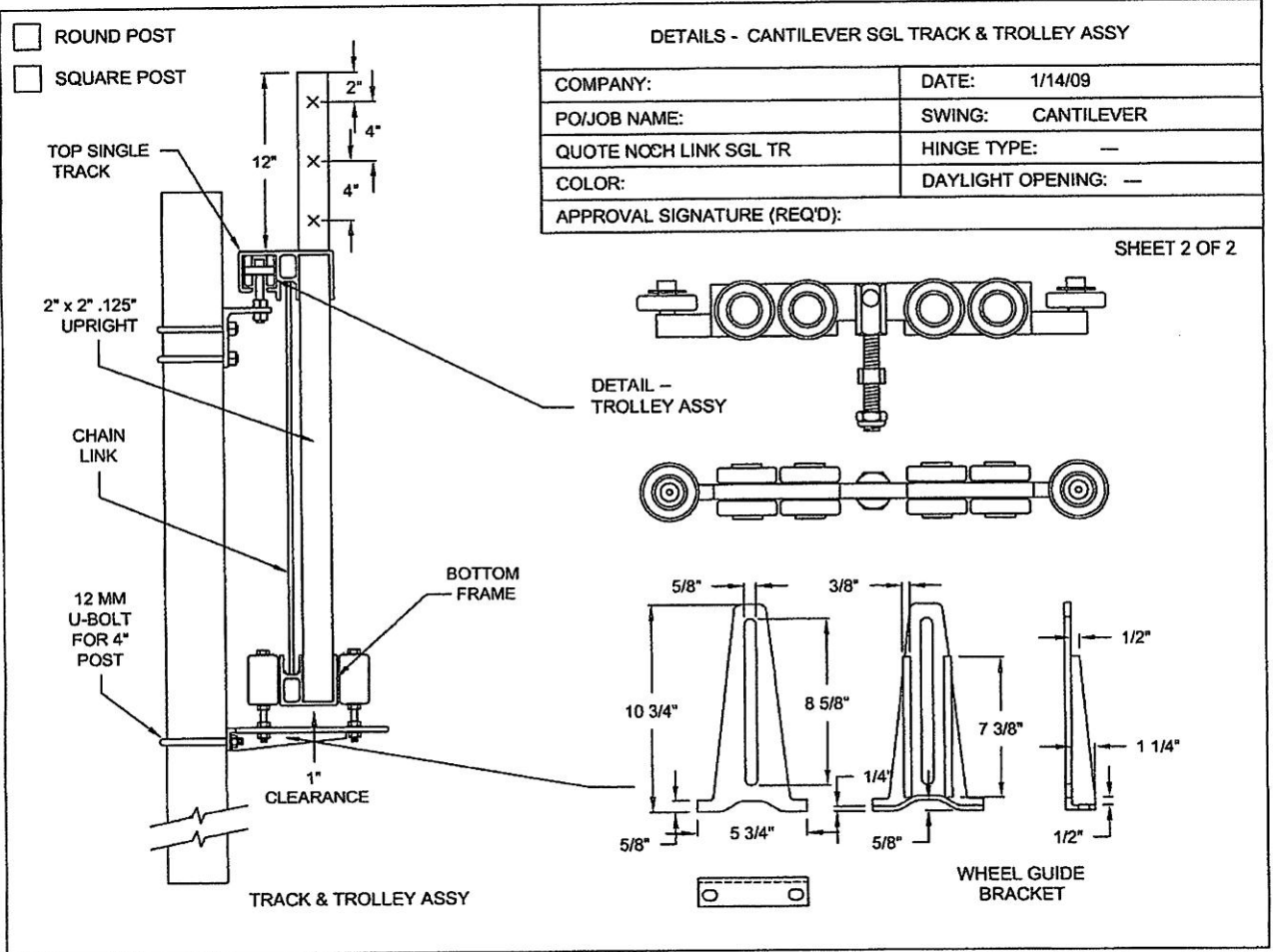
- A. Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written 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.

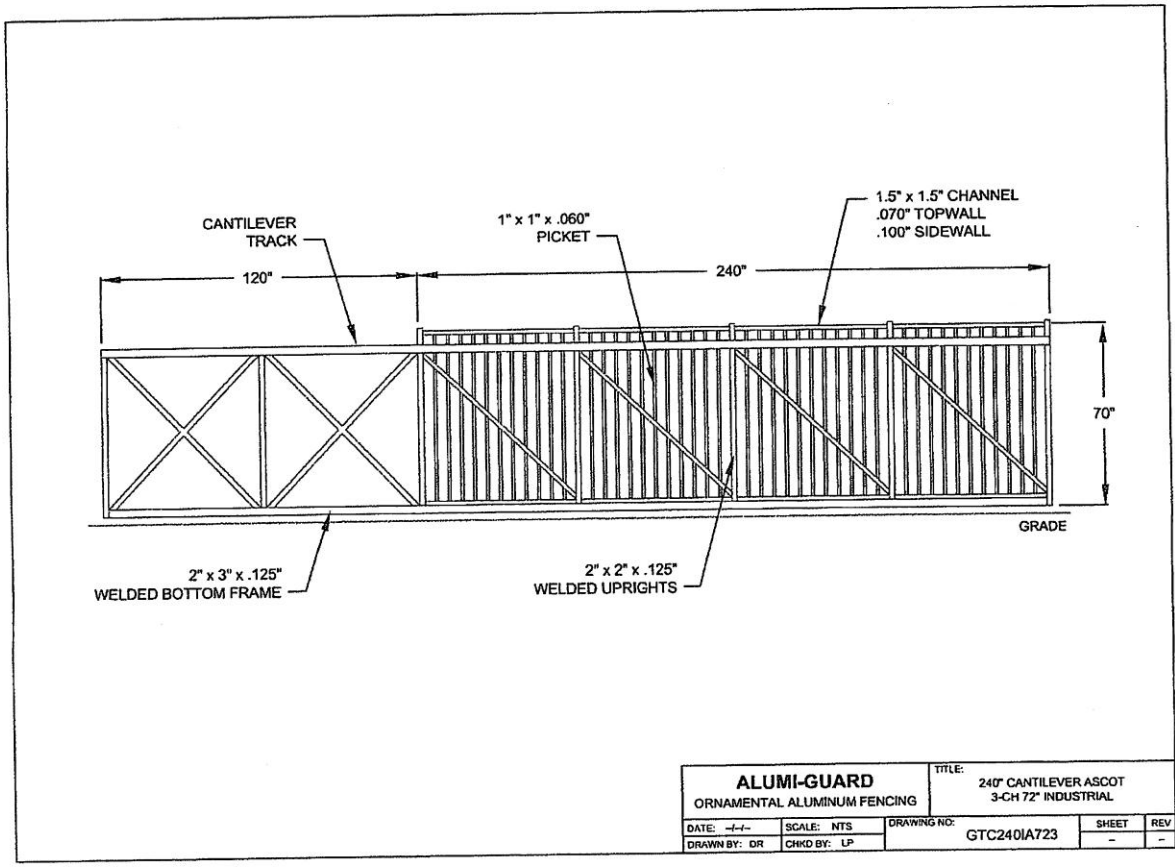
3.4 ATTACHING HANDRAILS TO WALLS

- 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