



ISSUED FOR CONSTRUCTION

Technical Specifications Revision 0

Johnsonville Fossil Plant Rock Buttressing (TVA Project ID 605792) New Johnsonville, Tennessee

Stantec Consulting Services Inc. Design with community in mind www.stantec.com Prepared for: Tennessee Valley Authority Chattanooga, Tennessee

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TECHNICAL SPECIFICATIONS

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TECHNICAL SPECIFICATIONS DIVISION 01 – GENERAL REQUIREMENTS SECTION 01 22 00 – SPECIAL PROVISIONS

PART 1 – GENERAL

1.1. RELATED DOCUMENTS

The conditions and description of Work shown in other sections of these Specifications, the Plans for Construction, the Construction Quality Assurance (CQA) Plan, and the Storm Water Pollution Prevention Plan (SWPPP) apply to this Section.

1.2. SUMMARY

- A. Section Includes:
 - 1. Special construction considerations.
 - 2. Sequencing.
 - 3. Submittals.
 - 4. Project information and definitions.
 - 5. Work covered by construction documents.
 - 6. Work covered by TVA.
 - 7. Use of premises.
 - 8. Work restrictions.
 - 9. Specification conventions.
 - 10. Record drawings ("as-builts").

1.3. PROJECT CONDITIONS

- A. Safety: All Work shall be conducted with due consideration for the safety of workmen.
- B. Traffic: Minimize interference with adjoining roads, walks, and other adjacent occupied or used facilities during construction operations.
 - 1. Do not close or obstruct roads, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

C. Utility Locator Service: Contractor shall locate and verify all utilities prior to construction activities to ensure there are no unforeseen conflicts with the construction improvements.

1.4. SPECIAL CONSTRUCTION CONSIDERATIONS

- A. Protection of Fuel Oil Pipeline: The Contractor shall not damage the above ground fuel oil pipeline that must be crossed to enter the construction site.
 - 1. A construction entrance that bridges over the fuel oil pipeline has been constructed and is shown on the Plans for Construction. The location of the construction entrance is shown on the Contractor Access/Staging Plan sheet. The Contractor shall use the construction entrance to provide access to the site for construction equipment and vehicles.
 - 2. Construction equipment and vehicles shall not exceed the weight standards for commercial vehicle operations on the Interstate Highway System established by the Federal Highway Administration.
 - 3. The construction entrance was constructed from a steel pipe arch, timber mats, crushed stone, and other materials. The Contractor and the CQA Manager (or a representative for the CQA Manager) shall observe the steel pipe arch daily for deflection or deformation. If any deflection or deformation of the arch is observed, the entrance shall be closed to vehicular traffic, and the observer shall notify the Owner and Engineer.
- B. Site Access: The Contractor shall maintain access roads so that no ponding water or rutting is observed. Maintenance shall include the placement of additional materials as necessary. The Contractor shall leave the access roads in good condition, as determined by the CQA Manager, at the end of construction.
- C. Limit of Disturbance: Do not disturb outside the Limits of Construction shown on the Plans for Construction except as required for the installation and maintenance of erosion prevention and sediment control materials or as directed by the Owner or CQA Manager. The Contractor shall install a temporary silt fence along the Kentucky Lake normal summer pool shoreline. No ground disturbance shall occur beyond the silt fence.

1.5. SEQUENCING

It shall be the sole responsibility of the Contractor to plan and implement construction sequences, to follow the Plans for Construction and the Specifications, and to protect any portions of the Work already completed.

1.6. SUBMITTALS

- A. The Contractor is responsible for all submittals outlined in the Specifications unless stated otherwise.
- B. Submittals not specified elsewhere are listed below:
 - Access Road and Maintenance Plan: Contractor shall submit plan at least ten (10) working days prior to the start of construction. The plan shall include a drawing indicating the Contractor's preferred access road alignment within the project site. The Contractor shall also issue for review a proposed access road cross-section indicating material types and thicknesses. The road cross-section shall be of the required thickness necessary to facilitate the Contractor's operations. The Contractor shall maintain the access road so that no

ponding water or rutting is observed. Maintenance shall include the placement of additional materials as necessary. The Contractor shall leave the access road in good condition, as determined by the CQA Manager, at the end of construction.

1.7. **PROJECT INFORMATION AND DEFINITIONS**

- A. Project Identification: Rock Buttressing.
- B. Project Location: Johnsonville Fossil Plant (JOF), New Johnsonville, Humphreys County, Tennessee.
- C. Engineer: Stantec Consulting Services Inc.
- D. Owner: Tennessee Valley Authority (TVA).
- E. Contractor: The party responsible for completion of the Project or designated portions thereof.
- F. Construction Quality Assurance Manager (CQA Manager): A party, independent from Manufacturer, Installer, and Contractor, responsible for observing and documenting activities related to overall project quality assurance and quality control during construction of the project.
 - 1. CQA Manager for this project shall be Mr. Stephen Bickel, PE.

1.8. WORK COVERED BY CONSTRUCTION DOCUMENTS

The Contractor shall provide all materials, labor, and equipment necessary for completion of the Project unless stated otherwise. The Plans for Construction and the Specifications are intended to provide the basis for proper completion of the Work suitable for the intended use of the Owner. Anything not expressly set forth but which is reasonably implied or necessary for proper performance of the Project shall be included at no additional cost to the Owner.

1.9. WORK COVERED BY TVA

- A. TVA shall be responsible for the following work tasks throughout construction unless otherwise directed by TVA:
 - 1. NDPES environmental permitting, inspection, and reporting.
 - 2. Submittal of notice of intent (NOI) to TDEC.
 - 3. Temporary and permanent signage required by TDEC.
 - 4. Non-potable water for the Contractor's use in daily dust suppression as required by the SWPPP.
 - 5. Site security.

1.10. USE OF PREMISES

A. General: Contractor shall have limited use of premises for construction operations as indicated on the Plans for Construction or as directed by the Owner.

- B. Use of Site: Except for areas designated on the Plans For Construction, or as indicated by the Owner, do not disturb portions of the site beyond areas in which Work is indicated.
- C. Staging and Stockpile Areas: The Contractor shall coordinate with the Owner regarding staging and stockpile areas.

1.11. WORK RESTRICTIONS

- A. Work Hours: Material deliveries and hauling for the Project shall not be permitted during the hours of normal plant shift change (6:30 to 7:00 AM and 3:30 to 3:45 PM central time.)
- B. Ongoing Projects: The Contractor shall not interfere with other construction projects occurring around the Project site. If a conflict arises, the Contractor shall notify the Owner immediately.

1.12. SPECIFICATION CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - 1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
 - 2. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
- B. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

1.13. RECORD DRAWINGS (AS-BUILTS)

- A. Record Prints: Maintain one set of blue- or black-line white prints of the Plans for Construction.
 - 1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally:
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an understandable drawing technique.
 - c. The Contractor shall record data as soon as possible after obtaining it.
 - d. The Contractor shall record and check the markup before enclosing concealed installations.
 - e. Record Prints shall be maintained up to date throughout construction.

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- 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to the Plans for Construction or Shop Drawings.
 - b. Revisions to details shown on the Plans for Construction or Shop Drawings.
 - c. Locations and depths of underground utilities.
 - d. Revisions to routing of piping and conduits.
 - e. Changes made by Change Order or Work Change Directive.
 - f. Changes made following Owner's and/or Engineer's written orders.
 - g. Details not on the original Plans for Construction.
 - h. Field records for variable and concealed conditions.
 - i. Record information on the Work that is shown only schematically.
- 3. Mark the Plans for Construction or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Plans for Construction.
- 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
- 5. Mark important additional information that was either shown schematically or omitted from the original Plans for Construction.
- 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Digital Records: The Contractor shall maintain as-built digital records in AutoCAD Civil 3D native format that fully documents the following elements:
 - 1. Existing Conditions Surface.
 - 2. Limits of LLDPE or HDPE Geomembrane.
 - 3. Top of LLDPE or HDPE Geomembrane.
 - 4. Top of Clay Fill.
 - 5. Final Grade Surface.
 - 6. Other items identified by the CQA Manager as necessary to prepare the construction certification report (CCR).
- C. Any noted deficiencies in Record Prints and Digital Records in association with the Work will be obtained by the Owner at the expense of the Contractor.

JOHNSONVILLE FOSSIL PLANT ROCK BUTTRESSING NEW JOHNSONVILLE, TENNESSEE DIVISION 01 – GENERAL REQUIREMENTS SECTION 01 22 00 – SPECIAL PROVISIONS

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 22 00

TECHNICAL SPECIFICATIONS DIVISION 31 – EARTHWORK SECTION 31 05 30 – GEOMEMBRANE

PART 1 - GENERAL

1.1. DESCRIPTION OF WORK

This Specification covers Linear Low Density Polyethylene (LLDPE) Geomembrane with textured surfaces on both sides and High Density Polyethylene (HDPE) Geomembrane with textured surfaces on both sides. The geomembrane shall conform to the current requirements of the Geosynthetic Research Institute Specification GM13 for HDPE or GM17 for LLDPE, latest editions, and the specifications herein. The Work for this section includes furnishing all labor, material, and equipment to complete installation of the geomembrane, including all necessary and incidental items, in accordance with the Plans for Construction and Specifications.

1.2. RELATED DOCUMENTS

- A. The conditions and description of Work shown in other sections of these Specifications, the Plans for Construction, and the Construction Quality Assurance (CQA) Plan apply to this Section.
- B. Related Sections:
 - 1. Section 01 22 00 Special Provisions
 - 2. Section 31 20 00 Earth Moving

1.3. SUMMARY

This Section includes the following:

- 1. Installation of LLDPE geomembrane.
- 2. Installation of HDPE geomembrane.

1.4. CODES AND STANDARDS

- A. The following codes, specifications, and standards (latest editions) of the American Society of Testing and Materials (ASTM) shall apply:
 - 1. ASTM D792, "Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement."
 - 2. ASTM D1004, "Standard Test Method for Initial Tear Resistance of Plastics Film and Sheeting."
 - 3. ASTM D1238, "Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer."
 - 4. ASTM D1505, "Standard Test Method for Density of Plastics by the Density-Gradient Technique."

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- 5. ASTM D1603, "Standard Test Method for Carbon Black Content in Olefin Plastics."
- 6. ASTM D3895, "Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry."
- 7. ASTM D4218, "Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique."
- 8. ASTM D4833, "Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products."
- 9. ASTM D5199, "Standard Test Method for Measuring Nominal Thickness of Geosynthetics."
- 10. ASTM D5397, "Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test."
- 11. ASTM D5323, "Standard Practice for Determination of 2% Secant Modulus for Polyethylene Geomembranes."
- 12. ASTM D5596, "Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics."
- 13. ASTM D5617, "Standard Test Method for Multi-Axial Tension Test for Geosynthetics."
- 14. ASTM D5641, "Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber."
- 15. ASTM D5721, "Standard Practice for Air-Oven Aging of Polyolefin Geomembranes."
- 16. ASTM D5820, "Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes."
- 17. ASTM D5885, "Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High-Pressure Differential Scanning Calorimetry."
- 18. ASTM D5994, "Standard Test Method for Measuring the Core Thickness of Textured Geomembranes."
- 19. ASTM D6370, "Standard Test Method for Rubber-Compositional Analysis by Thermogravimetry (TGA)."
- 20. ASTM D6392, "Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods."
- 21. ASTM D6693, "Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes."
- 22. ASTM D7466, "Standard Test Method for Measuring the Asperity Height of Textured Geomembranes."
- B. The following codes, specifications, and standards (latest editions) of the Geosynthetic Research Institute (GRI) shall apply:
 - 1. GRI GM14, "Test Methods, Test Properties, and Testing Frequency for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes."

2. GRI GM17, "Test Methods, Test Properties, and Testing Frequency for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes."

1.5. **DEFINITIONS**

- A. Geomembrane Manufacturer (Manufacturer): The party responsible for manufacturing the geomembrane.
- B. Geosynthetic Quality Control Laboratory (Testing Laboratory): A party, independent from TVA, Geomembrane Manufacturer, and Installer, responsible for conducting laboratory tests on samples of geosynthetics obtained at the site or during manufacturing, under the direction of the CQA Manager.
- C. Installer: A party responsible for field handling, onsite storing, deploying, seaming, and testing of the constructed geomembrane product.
- D. Lot: A quantity of resin (usually the capacity of one rail car) is used in the manufacture of polyethylene geomembrane rolls. The finished roll shall be identified by a roll number traceable to the resin lot used.
- E. Master Seamer: Field installation supervisor or crew foreman who has performed field production seaming for a minimum of three million square feet of the project specified, using the same type of seaming apparatus to be used on this project. The Master Seamer shall be present whenever field seaming is being performed.
- F. Panel: Unit area of a geomembrane that will be seamed in the field that is larger than 100 square feet.
- G. Sheet: Seamless piece of geomembrane.
- H. Contractor: The party responsible for completion of the Project or designated portions thereof.
- I. Subgrade Surface: The prepared surface layer which immediately underlies the geomembrane.

1.6. SUBMITTALS

- A. LLDPE Geomembrane: The Manufacturer shall furnish the following product data to the CQA Manager for approval at least ten (10) working days prior to shipment of the geomembrane material:
 - 1. Resin Data: Include a certification stating that the resin meets the Specification requirements of Table 1 in Paragraph 2.1.B.
 - 2. Geomembrane Roll: Include a statement certifying conformance with specified properties.
 - 3. Manufacturer's specifications, literature for each geomembrane furnished, and products used to complete installation.
- B. HDPE Geomembrane:

Submit a statement to the CQA Manager that the Owner-provided HDPE geomembrane will be used.

- C. The Contractor shall furnish geomembrane samples for shear box test to the CQA Manager at least four (4) weeks prior to shipment. Sample size to be specified by the CQA Manager.
- D. The Installer shall furnish a Proposed Layout and Installer Plan that includes the following to the CQA Manager for approval at least ten (10) working days prior to installation of the geomembrane material.
 - 1. Proposed Layout:
 - a. Proposed panel layout including field seams and details.
 - b. Proposed locations and types of temporary anchor trenches and 'stage divide' anchor trenches (if applicable).
 - c. Drawings shall be approved prior to installing the geomembrane. Approved drawings will be conceptual only and actual panel placement will be determined by site conditions.
 - 2. Installer Plan: Installer's Geosynthetic Field Installation Quality Control Plan.
- E. The Installer shall inspect that the surface upon which the geomembrane is to be installed is acceptable and provide certification in writing to the CQA Manager. The Installer shall submit the following Certifications and As-Builts to the CQA Manager upon completion of installation:
 - 1. Certificate stating that the geomembrane has been installed in accordance with the Construction Documents.
 - 2. Material and installation warranties.
 - 3. Record Drawings (As-Builts) showing the location of all field panels, seams, sample locations, penetrations, patches and repairs, and a typical anchor trench detail.
 - 4. Complete records on all repairs, overlap locations, and panel placement.

1.7. WARRANTY

- A. LLDPE material shall be warranted, on a pro-rated basis against Manufacturer's defects for a period of five (5) years from the date of geomembrane installation.
- B. Installation of LLDPE or HDPE material shall be warranted against defects in workmanship for a period of one (1) year from the date of geomembrane installation.

PART 2 - PRODUCTS

2.1. GEOMEMBRANE

- A. Geomembrane shall be either LLDPE or HDPE.
- B. LLDPE Geomembrane:
 - 1. Material: 40 mil textured Linear Low-Density Polyethylene (LLDPE) Geomembrane.

2. Resin: New, first quality, compounded, and manufactured specifically for producing geomembrane. Natural resin (without carbon black) shall meet the minimum requirements shown in Table 1.

Property	Test Method	Value
Density [g/cm ³]	ASTM D1505	0.915 - 0.926
Melt Flow Index [g/10 minutes]	ASTM D1238 (190°C/2.16 kg)	≤1.0
Oxidative Induction Time (OIT) [minutes]	ASTM D3895 (200°C/1 atm O ₂)	≥100

C. HDPE Geomembrane:

- 1. Material: 40 mil textured High Density Polyethylene (HDPE) Geomembrane.
- 2. Shall be Agru America High Density Polyethylene MicroSpike Liner or approved equal.

2.2. MANUFACTURING AND QUALITY CONTROL

Geomembrane Rolls:

- 3. Geomembrane shall not exceed a combined maximum total of one (1) percent by weight of additives other than carbon black.
- 4. Geomembrane shall be free of holes, pinholes as verified by on-line electrical detection, bubbles, blisters, excessive contamination by foreign matter, and nicks and cuts on roll edges.
- 5. All geomembrane sheets produced at the factory shall be tested by an acceptable method of inspecting for pinholes. Inspection of pinholes shall be performed using standard industry practice. If pinholes are located, identified, and indicated during manufacturing, these pinholes may be corrected during installation.
- 6. All LLDPE geomembrane sheets produced at the factory shall be inspected prior to shipment for compliance with the physical property requirements listed in Table 2.
- 7. All HDPE geomembrane sheets produced at the factory and sourced from a supplier other than the Owner shall be inspected prior to shipment for compliance with the physical property requirements listed in GRI GM13.

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DIVISION 31 – EARTHWORK SECTION 31 05 30 – GEOMEMBRANE

Property	Test Method	Units	MAV ⁷	Frequency ¹
Thickness	ASTM D5994	mil (mm)	40	Per roll
Minimum average			38	
Lowest individual of 8 of 10 readings			36	
Lowest individual of 10 readings			34	
Asperity Height	ASTM D7466	mil (mm)	10	Every 2nd roll
Sheet Density (max.)	ASTM D1505 or D792	g/cm ³	0.939	200,000 lb.
Tensile Properties ²	ASTM D6693			20,000 lb.
1. Break Strength		lb/in	60	
2. Break Elongation		%	250	
2% Modulus (max.)	ASTM D5323	lb/in ²	2,400	Per formulation
Tear Resistance	ASTM D1004	lb	22	45,000 lb.
Puncture Resistance	ASTM D4833	lb	44	45,000 lb.
Axi-Symmetric Break Strain	ASTM D5617	%	30	Per formulation
Carbon Black Content ³	ASTM D1603	%	2.0-3.0	45,000 lb.
Carbon Black Dispersion ⁴	ASTM D5596		-Note 3-	45,000 lb.
Oxidative Induction Time (OIT)				200,000 lb.
Standard OIT (200°C/1 atm O ₂)	ASTM D3895	minutes	100	
- OR -				
High Pressure OIT	ASTM D5885	minutes	400	
Oven Aging at 85°C	ASTM D5721			
With High Pressure OIT (% retained after 90 days)	ASTM D5885	%	60	Per formulation
- OR -				
With Standard OIT (% retained after 90 days)	ASTM D 3895	%	35	Per formulation
UV Resistance ⁵	ASTM D 7238			
With High Pressure OIT ⁶ (% retained after 1,600 hours)	ASTM D 5885	%	35	Per formulation

Table 2: LLDPE Geomembrane Requirements

1. Minimum Manufacturer Quality Control Testing Frequency.

 Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction. Break elongation is calculated using a gauge length of 2.0 inches.

3. Other methods such as ASTM D4218 or microwave methods are acceptable if an appropriate correlation can be established.

4. Carbon black dispersion for 10 different views: All 9 in Categories 1 and 2 with one allowed in category 3.

5. The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation 60°C.

6. UV resistance is based on percent retained value regardless of the original HP-OIT value.

7. MAV = Minimum Average Value

2.3. SEAMING EQUIPMENT

- A. Approved processes for field welding are hot wedge ("fusion") welding and extrusion welding. Alternate welding processes may be used with written approval from the CQA Manager.
- B. An adequate number of welding apparatuses shall be available to avoid delaying work.

- C. Power sources capable of providing constant voltage under combined line load shall be used.
- D. Hot wedge ("Fusion") welding apparatus:
 - 1. Shall be an automated, self-propelled device that produces a double seam with an enclosed air channel for air pressure testing.
 - 2. Shall be equipped with gauges giving applicable temperature and speed settings.
- E. Extrusion welding apparatus: Shall be equipped with gauges giving the temperature of the apparatus at both the nozzle and the extruder barrel.

2.4. EXTRUDATE ROD AND BEAD

- A. Extrudate material shall be made from same type resin as the geomembrane. Extrudate material shall be HDPE when welding LLDPE geomembrane to HDPE geomembrane.
- B. Additives shall be thoroughly dispersed.
- C. Materials shall be free of contamination by moisture or foreign matter.

2.5. INTERFACE FRICTION ANGLE

Test according to requirements of CQA Plan. Large-Scale direct shear test parameters are outlined in the CQA Plan.

PART 3 - EXECUTION

3.1. DELIVERY, STORAGE, AND HANDLING

- A. Labeling: Each roll of geomembrane delivered to the site shall be labeled by the Manufacturer. The label shall identify:
 - 1. Manufacturer's Name.
 - 2. Product Identification.
 - 3. Thickness.
 - 4. Length.
 - 5. Width.
 - 6. Roll Number.
- B. Delivery: Rolls of geomembrane shall be prepared to ship by appropriate means to prevent damage to the material and to facilitate off-loading.
- C. Material certification shall be provided on the shipped material.
- D. Storage: The on-site storage location for geomembrane material will be provided by the Owner. The Installer shall be responsible for preparing the storage area in such a manner as to protect

the geomembrane from punctures, abrasions, and excessive dirt and moisture. The storage area shall have the following characteristics:

- 1. Level (No wooden pallets).
- 2. Smooth.
- 3. Dry.
- 4. Protected from UV exposure.
- 5. Protected from theft and vandalism.
- E. Handling: Materials shall be handled so as to prevent damage.
- F. Store epoxy adhesive in temperatures above 60°F and dispose of cartridges if shelf life has expired. If stored at temperatures below 60°F, manufacturer shall provide certification demonstrating that the adhesive meets the specified requirements.

3.2. DEPLOYMENT

- A. Panel Numbering: Each panel shall be assigned a simple and logical identifying code. The coding system shall be subject to approval CQA Manager and shall be determined at the job site.
- B. Visual Inspection:
 - 1. Visually inspect the subgrade surface for smoothness and the presence of sharp stones, sticks, roots, sharp objects, or any other object that could penetrate the geomembrane. Rock fragments larger than one (1) inch in any dimension shall be removed from the surface prior to deployment in accordance with manufacturer recommendations and these Specifications.
 - 2. Visually inspect the geomembrane during deployment for imperfections and mark the faulty or suspect areas.
- C. Deployment: Geomembrane panels shall be deployed in a manner that will comply with the following guidelines:
 - 1. Geomembrane panels shall be placed one at a time. Each panel shall be seamed immediately after its placement.
 - 2. Unroll geomembrane panels using methods that will not damage geomembrane or underlying geotextile and will protect underlying surface from damage (e.g., spreader bar, protected equipment bucket).
 - 3. Place ballast on geomembrane that will not damage geomembrane (commonly sandbags) to prevent wind uplift.
 - 4. Personnel working on geomembrane shall not smoke, engage in activities that could damage the geomembrane, or wear shoes that could damage the geomembrane.
 - 5. Do not allow heavy vehicular traffic directly on geomembrane. Rubber-tired ATVs and other vehicles are acceptable if ground contact pressure is six (6) psi or less, the tire treads are

clean and free of embedded objects, and they are operated in a manner that does not distress the constructed geomembrane product.

- 6. Protect geomembrane in areas of heavy traffic by placing protective cover over the geomembrane.
- 7. Geomembrane deployment shall proceed between ambient temperatures of 32 degrees Fahrenheit and 104 degrees Fahrenheit.
 - a. Placement can proceed below 32 degrees Fahrenheit only after it has been verified by the Installer that the material can be seamed according to the specification.
- 8. Geomembrane placement shall not be done during any precipitation, in the presence of excessive moisture (e.g., fog, rain, dew), on frozen material, or in the presence of excessive winds, as determined by the Installer.
- 9. Sufficient slack in the material shall be provided to allow for thermal expansion and contraction.

3.3. FIELD SEAMING

- A. Seams: Seams shall meet the following requirements:
 - 1. To the maximum extent possible, orient seams parallel to line of slope, i.e., down and not across slope.
 - 2. Minimize number of field seams in corners, odd-shaped geometric locations, and outside corners.
 - 3. Slope seams (panels) shall extend a minimum of ten (10) feet beyond grade breaks (i.e., changes in slope ten (10) percent or greater) into the adjacent flat area.
 - 4. Use a sequential seam numbering system compatible with panel numbering system that is agreeable to the CQA Manager and Installer.
 - 5. Align seam overlaps consistent with the requirements of the welding equipment being used. An overlap of six (6) inches is commonly suggested for hot wedge welding and an overlap of three (3) inches is commonly suggested for extrusion welding.
 - 6. Cap all "T-joints" at panel intersections. A T-joint is where more than two (2) panels adjoin and are welded one on top of the other. Capping is welding over the top of this junction.
- B. Welding Operations:
 - 1. Provide at least one Master Seamer who shall provide direct supervision over other welders as necessary.
 - 2. Hot wedge ("Fusion") welding shall be the primary seaming system for geomembrane installation. Extrusion welding shall be utilized for repairs, "T-joints," detail work, and irregular seam areas such as pipe boots.
 - 3. Geomembrane sheets which are overlapped must be free of moisture in the area of the seam. Installer shall protect against moisture build-up between sheets.

- 4. Clean seam area of dust, mud, moisture, debris, and other foreign materials immediately prior to welding operations and protect from wind.
 - a. Extrusion welding: Remove texturing by a disc grinder or equivalent. Grinding shall precede the welding as closely as possible.
- 5. Welding operations shall not proceed during rain or snow.
- 6. Welding operations can proceed below 32 degrees Fahrenheit only after it has been verified by the Installer that acceptable trial welds have been performed under actual welding conditions.
- 7. Hot wedge welding:
 - a. Grinding in the seam area shall not be permitted.
 - b. The wedge shall be inspected to see that it is uniform and reasonably tapered.
 - c. Rollers for applying pressure on the sheets and driving the welding apparatus shall be inspected for wear.
 - d. The wedge, rollers, and other parts of the apparatus that come into contact with the geomembrane shall be inspected for sharp surfaces that may damage the geomembrane.
 - e. The apparatus shall be adjusted to assure contact between the geomembrane sheets and the wedge as the sheets pass through the apparatus. The temperature, speed, and roller force shall be adjusted according to geomembrane thickness and ambient factors.
 - f. Temperature controls on the apparatus and the completed seam coming out of the apparatus shall be continuously monitored during welding operations and adjustments made to speed to maintain a consistent welded seam.
 - g. All hot wedge welded seams shall be non-destructively air pressure tested.
- 8. Extrusion Welding:
 - a. Clean geomembrane surfaces and remove texturing by disc grinder or equivalent.
 - b. The welding apparatus shall be set up for the geomembrane being seamed.
 - c. The welding apparatus shall be inspected before it is heated to confirm that the apparatus is in good working order and that the welding nozzle is correct for the geomembrane being seamed.
 - d. Hot-air tack adjacent pieces together prior to extrusion welding using procedures that do not damage geomembrane.
 - e. Purge the extrusion welding apparatus of all degraded extrudate prior to welding.
 - f. All extrusion welds shall be non-destructively tested by vacuum testing.

- C. Trial Welds: Seaming shall not proceed when ambient air temperature or adverse weather conditions jeopardize the integrity of the geomembrane installation. Installer shall demonstrate that acceptable seaming can be performed by completing acceptable trial welds. Trial welds shall meet the following conditions:
 - 1. Prior to production seaming by any operator and each welding device, perform trial welds on geomembrane samples to verify welding equipment is operating properly.
 - 2. Make trial welds under the same surface and environmental conditions as the production welds, i.e., in contact with subgrade and similar ambient temperature.
 - 3. Make a minimum of two (2) trial welds per day, per welding apparatus. A minimum of one trial weld shall be made prior to the start of work and a minimum of one trial weld shall be completed at mid shift.
 - 4. Cut four (4) test strips from each trial weld. Each test strip shall be one (1) inch wide by six (6) inches long.
 - 5. Quantitatively test specimens for peel adhesion, and then for bonded seam strength (shear).
 - 6. Trial weld specimens shall pass when the results shown in Table 3 are achieved in both peel and shear test.
 - a. The break, when peel testing, occurs in the geomembrane material itself, not through peel separation (film tear bond).
 - b. The break is ductile.

Table 3: Peel and Shear Test Properties

Property	Test Method	LLDPE Values	HDPE Values
Peel Strength (fusion/extrusion), lbs/in	ASTM D6392	50/44	60/52
Shear Strength (fusion & extrusion), lbs/in	ASTM D6392	60	80

- 7. Repeat the trial weld, in its entirety, when any of the trial weld samples fail in either peel or shear.
- 8. No welding equipment or welder shall be allowed to perform production welds until equipment and welders have successfully completed trial weld.
- D. Defects and Repairs:
 - 1. Examine all seams and non-seam areas of the geomembrane for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter.
 - 2. Repair and non-destructively test each suspect location in both seam and non-seam areas. Do not cover geomembrane at locations that have been repaired until test results with passing values are available.

3.4. FIELD QUALITY CONTROL

- A. Manufacturer and Installer shall participate in and conform to all terms and requirements of the quality control program. CQA Manager shall be responsible for assuring this participation. Quality control requirements are as specified in this Section and in the CQA Plan.
- B. Field Testing:
 - 1. Non-destructive testing shall be carried out either as the seaming progresses or after completion of all field seaming.
 - a. Vacuum Testing: Perform in accordance with ASTM D5641.
 - b. Air Pressure Testing: Perform in accordance with ASTM D5820.
 - c. Other test methods may be used with approval by the CQA Manager.
 - 2. Destructive testing shall not be performed unless directed by the CQA Manager, the Master Seamer, or the Installer.
- C. Failed Seam Procedures:
 - 1. Installer shall follow one of the following options when a seam fails by non-destructive testing:
 - a. Reconstruct the seam between any two (2) passed test locations.
 - b. Trace the weld to an intermediate location at least ten (10) feet from the location of the failed test or to where the seam ends in both directions.
 - c. Install a cap strip over the entire length of the failed seam. The cap shall be of the same geomembrane material and shall extend a minimum of six (6) inches beyond the edge of the failed same in all directions. All corners of the cap strip shall be rounded with a minimum radius of three (3) inches.
 - 2. Trial welds shall be performed using the same welding device following the procedures in Paragraph 3.3.C to verify welding equipment is operating properly and ambient conditions permit acceptable welds. The welding device shall not be allowed to perform production welds until an acceptable trail weld has been successfully completed.

3.5. REPAIRS

- A. Installer shall be responsible for repair of defective areas.
- B. Remove damaged geomembrane and replace with acceptable geomembrane materials if damage cannot be satisfactorily repaired. Repair any portion of unsatisfactory geomembrane or seam area failing a destructive or non-destructive test. Agreement upon the appropriate repair method shall be decided between CQA Manager and Installer by using one of the following repair methods:
 - 1. Patching: Used to repair large holes, tears, undispersed raw materials, and seams contaminated by foreign matter.

- 2. Spot Welding: Used to repair pinholes or other minor, localized flaws, or where geomembrane thickness has been reduced.
- 3. Capping: Used to repair long lengths of failed seams.
- 4. Flap Welding: Used to extrusion weld the flap (i.e., the excess outer portion) of a fusion weld in lieu of a full cap.
- 5. Replace the unacceptable seam with new material.
- C. The following procedures shall be observed when a repair method is used:
 - 1. All geomembrane surfaces shall be clean and dry at the time of repair.
 - 2. Surfaces of the geomembrane which are to be repaired by extrusion welds shall be lightly abraded to assure cleanliness and grinding to remove texturing.
 - 3. Extend patches or caps at least six (6) inches for extrusion welds and four (4) inches for wedge welds beyond the edge of the defect, and around all corners of patch material.
- D. Repair Verification:
 - 1. Number and log each patch repair (performed by Installer).
 - 2. Non-destructively test each repair using methods specified in this Specification.

3.6. LINES AND GRADES

Subgrade shall be verified to be constructed to the lines, grades, and cross sections indicated on the Plans, unless otherwise directed by the CQA Manager prior to geomembrane deployment. The CQA Manager reserves the right to increase or decrease embankment slopes or make other changes in embankment sections as may be deemed necessary based on site conditions encountered.

END OF SECTION 31 05 30

TECHNICAL SPECIFICATIONS DIVISION 31 – EARTHWORK SECTION 31 10 00 – SITE CLEARING

PART 1 - GENERAL

1.1. DESCRIPTION OF WORK

This Specification covers the activities associated with site clearing and site preparation. The Work for this Section includes furnishing all labor, materials, and equipment to complete site clearing and site preparation, including clearing, grubbing, stripping, demolition, and disposal of waste materials, including all necessary and incidental items, in accordance with the Plans for Construction and Specifications.

1.2. RELATED DOCUMENTS

- A. The conditions and description of Work shown in other sections of these Specifications, the Plans for Construction, the Construction Quality Assurance (CQA) Plan, and the Storm Water Pollution Prevention Plan (SWPPP) apply to this Section.
- B. Related Sections:
 - 1. Section 01 22 00 Special Provisions
 - 2. Section 31 20 00 Earth Moving
 - 3. Section 31 25 00 Erosion and Sediment Controls

1.3. SUMMARY

- A. This section includes the following:
 - 1. Interrupting existing utilities.
 - 2. Clearing and grubbing.
 - 3. Topsoil stripping and stockpiling.
 - 4. Selective demolition.
 - 5. Disposal of surplus and waste material.

1.4. CODES AND STANDARDS

- A. The following codes, specifications, and standards (latest editions) shall apply:
 - 1. American National Standard Institute (ANSI) A10.6, "Standard Requirements for Demolition for Construction and Demolition Operations."

- 2. Tennessee Department of Environment and Conservation (TDEC), "Tennessee Erosion and Sediment Control Handbook."
- B. Comply with all laws, rules, and regulations of governmental authorities having jurisdiction over the demolition work.

1.5. **DEFINITIONS**

- A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the exiting soil profile at the Project site. The surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing in-place surface soil and is the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than the underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects greater than two (2) inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.
- D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.6. MATERIAL OWNERSHIP

Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain the Owner's property, cleared materials shall become the Contractor's property and shall be removed from the Project site.

1.7. SUBMITTALS

- A. The Contractor shall submit the following to the CQA Manager at least ten (10) working days prior to the beginning of work:
 - 1. Disposal plan identifying an off-site location(s) for disposal of debris.
 - 2. Copies of disposal site permits.

1.8. PROJECT CONDITIONS

Contractor shall not commence site clearing operations until temporary erosion and sedimentation control measures are in place as described in the SWPPP, the Specifications, and the Plans for Construction.

PART 2 - PRODUCTS

2.1. RIVER GRAVEL

River gravel shall comply with the requirements of Section 31 20 00 – Earth Moving.

PART 3 - EXECUTION

3.1. **PREPARATION**

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Locate and clearly identify limits of construction in the field.
- C. Protect existing site improvements to prevent damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to the Owner.
- D. Work shall be completed in such a manner as to avoid hazards to persons and property and interference with the use of adjacent areas or interruption of free passage to and from such areas.
- E. Care shall be taken to prevent the spread of dust and flying particles.

3.2. EXISTING UTILITIES

- A. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify CQA Manager not less than two (2) days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Owner's written permission.
 - 3. Arrange with utility companies to shut off utilities.

3.3. CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction. Removal includes digging out stumps and obstructions and grubbing roots. Completely remove stumps, roots, obstructions, and debris extending to a depth of eighteen (18) inches below exposed subgrade. In general, all trees and brush with a mean diameter of two (2) inches or greater at ground level shall be grubbed out. Where it is not reasonable to remove trees by mowing with a bush hog or with similar mowing equipment, the following guidelines apply:
 - 1. All trees shall be cut using a handsaw or chainsaw and the cut tree and branches discarded.
 - 2. Remove the remaining tree trunk, stump, and rootwad.
 - 3. Grub any remaining roots of the tree so that only roots two (2) inches or smaller are left in place.
 - 4. The resulting cavity from removal of the rootwad shall be cleaned of loose soil and debris.
 - 5. The cavity shall then be backfilled with river gravel. Place the river gravel in horizontal layers not exceeding a loose depth of twelve (12) inches. Tamp each layer with a backhoe bucket. Grade to blend and match adjacent slopes to provide a smooth surface.

- B. Trees, shrubs, grass, and other vegetation that are cleared are considered waste material.
 - 1. Waste material shall be removed from the project site and not stored, stockpiled, or disposed on the site, unless the Owner grants permission in writing.

3.4. TOPSOIL STRIPPING AND STOCKPILING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil in a manner to prevent intermingling with underlying subsoil or other waste materials.
- C. Stockpile topsoil in locations approved by the CQA Manager and the Owner. Prevent intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water. Provide erosion and sedimentation control measures in accordance with the Specifications and the SWPPP.

3.5. SELECTIVE DEMOLITION

- A. Contractor shall remove the existing chain link fence as indicated on the Plans for Construction.
- B. Existing above and below grade improvements may be removed if necessary to facilitate new construction with approval by the CQA Manager and the Owner. Do not proceed with removal without Owner's written permission.

3.6. DISPOSAL OF SURPLUS AND WASTE MATERIAL

- A. Remove surplus soil material, topsoil, obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose of them off the Owner's property at a permitted disposal location.
- B. Contractor is responsible for identifying a permitted, off-site disposal location for the disposal of surplus and waste material.

END OF SECTION 31 10 00

TECHNICAL SPECIFICATIONS DIVISION 31 – EARTHWORK SECTION 31 20 00 – EARTH MOVING

PART 1 - GENERAL

1.1. DESCRIPTION OF WORK

This Specification covers the activities associated with excavation, subgrade preparation, backfill placement, clay cap construction, and riprap placement. The Work for this Section includes furnishing all labor, materials, and equipment to complete earth moving work, including all necessary and incidental items, in accordance with the Plans for Construction and Specifications.

1.2. RELATED DOCUMENTS

- A. The conditions and description of Work shown in other sections of these Specifications, the Plans for Construction, the Construction Quality Assurance (CQA) Plan, and the Storm Water Pollution Prevention Plan (SWPPP) apply to this Section.
- B. Related Sections:
 - 1. Section 01 22 00 Special Provisions
 - 2. Section 31 10 00 Site Clearing
 - 3. Section 31 25 00 Erosion and Sediment Controls
 - 4. Section 32 92 00 Turf and Grasses

1.3. SUMMARY

- A. This Section includes the following:
 - 1. Excavation.
 - 2. Backfill.
 - 3. Clay cap.
 - 4. Vegetative cover.
 - 5. Compaction requirements.
 - 6. Soil moisture control.
 - 7. Roadways.

1.4. CODES AND STANDARDS

- A. The following codes, specifications, and standards (latest editions) of the American Society of Testing and Materials (ASTM) shall apply:
 - 1. ASTM D698, "Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³)."
 - 2. ASTM D2487, "Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)."
 - 3. ASTM D5084, "Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter."
 - 4. ASTM D6938, "Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)."
- B. The following codes, specifications, and standards (latest editions) of the Tennessee Department of Transportation (TDOT) shall apply:
 - 1. TDOT, "Standard Specifications for Road and Bridge Construction (Standard Specifications)," Section 709.
 - 2. TDOT, "Standard Specifications for Road and Bridge Construction (Standard Specifications)," Section 802.
 - 3. TDOT, "Standard Specifications for Road and Bridge Construction (Standard Specifications)," Section 903.

1.5. **DEFINITIONS**

- A. Backfill: Material used to fill an excavation.
- B. Borrow Soil: Satisfactory soil imported from on-site or off-site for use as fill, backfill, clay cap, or vegetative cover.
- C. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
 - Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by CQA Manager. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
 - 2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by the CQA Manager. Unauthorized excavation, as well as remedial work directed by CQA Manager as a result of the unauthorized excavation, shall be without additional compensation.
- D. Fill: Soil material used to raise existing grades.

- E. Satisfactory Soil: Soil material meeting the requirements outlined in Part 2 of this Specification for clay cap or vegetative cover.
- F. Subgrade: Uppermost surface of an excavation or the top surface of a fill immediately below subbase or geosynthetic layers.
- G. Unsatisfactory Soil: Soil material that does not meet the requirements for Satisfactory Soils.
- H. Vegetative Cover: Topsoil or amended soil fill capable of supporting vegetation.

1.6. SUBMITTALS

- A. The Contractor shall submit the following to the CQA Manager at least ten (10) working days prior to the beginning of work:
 - 1. Certifications for each material indicating that the source of material is an approved source per the TDOT Producer/Supplier List.
 - 2. Submittals for each material to show conformance to these Specifications and the Plans for Construction.
- B. All materials shall be subjected to the testing schedules listed in the CQA Plan and referenced sections of the Specifications.

1.7. **PROJECT CONDITIONS**

- A. Contractor shall not commence earth moving operations until temporary erosion and sedimentation control measures are in place as described in the SWPPP and the Specifications.
- B. Avoid direct skin contact with residual materials. Excavate only to where indicated on Plans. Avoid over excavation.

PART 2 - MATERIALS

2.1. Aggregate and Riprap

- A. Crusher Run: Crusher Run shall meet the requirements of Subsection 903.04, "Aggregate for Lean Concrete Base," of the TDOT Standard Specifications. The aggregate shall be Type B, Grading D.
- B. Crushed Stone: No. 57 crushed stone, No. 3 crushed stone, and No. 2 crushed stone shall consist of quarried stone meeting the requirements of Section 903 of the TDOT Standard Specifications. The gradations shall conform to Table 1 (AASHTO M43) in Subsection 903.22, "Sizes of Coarse Aggregate," of the TDOT Standard Specifications.
- C. Riprap: TDOT Class A-1 Riprap and TDOT Class B Riprap shall consist of quarried stone meeting the requirements of Section 709 of the TDOT Standard Specifications.
- D. River Gravel: Natural gravel dredged from the Tennessee River; capable of withstanding the effects of handling, spreading, and compacting without degradation or production of deleterious fines; and free of shale, clay, and soft fragments.

- 1. Gradation: 100 percent passing a 1-inch sieve; 25 percent or more by weight retained on 3/4-inch sieve; and not more than 8 percent by weight passing a No. 4 sieve.
- 2. Approved Suppliers: Herbert SanGravl Co.

2.2. CLAY CAP

- A. Soils used for the clay cap shall meet the following requirements:
 - 1. Classification: Soils shall exhibit a classification of Soil Classification Groups CL or CH according to ASTM D2487.
 - Permeability: Soils shall have a maximum permeability of 1x10⁻⁷ cm/sec according to ASTM D5084.
 - 3. Soils shall be free of rock or gravel larger than three (3) inch in any dimension, debris, waste, frozen materials, vegetation, and other deleterious material.
- B. The Contractor shall be responsible for obtaining soils used for the clay cap from an approved borrow site. The Contractor shall be responsible for negotiations with the supplier.
 - 1. Approved Borrow Site: Waggoner Farms.

2.3. VEGETATIVE COVER

- A. Soils used for vegetative cover shall meet the requirements for topsoil set forth in Subsection 802.02, "Materials," of the TDOT Standard Specifications.
- B. Soils used shall be suitable to support vegetation and reasonably free from deleterious matter that would prevent the formation of a suitable seedbed.

PART 3 - EXECUTION

3.1. **PREPARATION**

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Protect structures, utilities, instrumentation, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.
- C. The Contractor shall be responsible for the maintenance of all access roads, staging areas, and storage areas used during construction and shall restore said areas to their original condition or better once construction is complete. Actions must be taken to minimize the tracking of mud and soil from the project area onto the existing crushed stone access roads. Soil or mud tracked onto the access roads shall be removed daily.
- D. Stockpiles for excavated materials and fill materials shall be located in areas designated on the Plans for Construction and approved by the CQA Manager and the Owner.

3.2. DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3. EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, coal combustion products (CCP), and obstructions.
- B. Satisfactory material removed from the excavations shall be used insofar as practicable in constructing the permanent works. The Contractor shall obtain approval from the CQA Manager for use of excavated materials.
- C. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials. Unsatisfactory soil materials and rock shall be placed within the limits of Ash Area No. 1, spread, and graded to drain at the direction of the CQA Manager. Materials shall be covered with six (6) inches of vegetative cover and stabilized within seven (7) days.
- D. All excavations shall be prepared in accordance with the Occupational Safety and Health Administration (OSHA) standards. Stability of excavation slopes is the responsibility of the Contractor.

3.4. SUBGRADE INSPECTION

- A. Contractor shall notify CQA Manager when excavations have reached required subgrade.
- B. If CQA Manager determines that unsatisfactory subgrade conditions, materials, or soft areas are present, continue authorized additional excavation and replace with compacted backfill or crushed stone and geogrid as directed by the CQA Manager.
- C. If required, proof-roll subgrade with a pneumatic-tired and loaded 10-wheel, tandem-axle truck weighing not less than 15 tons and having a ground contact pressure of 35 psi, or other vehicle approved by the CQA Manager, to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 - 1. Completely proof-roll subgrade in one direction. Limit vehicle speed to three (3) mph.
 - 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting and replace with compacted backfill or fill as directed.
 - a. Pumping or rutting three (3) inches or greater shall be considered excessive.
- D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the CQA Manager, without additional compensation.

3.5. STOCKPILES

- A. Locations and size of temporary stockpiles shall be approved by the CQA Manager and the Owner prior to material placements. Stockpiles shall be graded to maintain positive drainage at all times. Materials shall be segregated as directed by the CQA Manager.
- B. Stockpile different types of materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust. Stockpile materials away from edge of excavations.
- C. Provide erosion and sedimentation control measures in accordance with the Specifications and the SWPPP.

3.6. BACKFILL, GENERAL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Surveying locations of underground utilities for Record Drawings.
 - 2. Testing and inspecting underground utilities.
 - 3. Removing trash and debris.
 - 4. Removing temporary shoring and bracing, and sheeting.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.7. CLAY CAP

- A. Place clay cap material to the lines and grades shown on the Plans for Construction.
- B. Soil for the clay cap shall be placed in lifts not more than eight (8) inches in loose depth and compacted per the requirements of subsection 3.11 of this Specification.

3.8. VEGETATIVE COVER

- A. Vegetative cover shall not be placed over the clay cap until the clay cap has been approved by the CQA Manager.
 - 1. Scarify or break up smooth surfaces of cap soil to promote bonding with vegetative cover.
 - Vegetative cover material shall be spread and tracked in place. Track cleat marks shall be made by equipment travelling perpendicular to the contour and result in cleat marks parallel to the contour. Place six (6) inches of vegetative cover over capped areas unless indicated otherwise on the Plans for Construction.
 - Soil enhancements shall be added to the vegetative cover as prescribed in Section 32 92 00

 Turfs and Grasses.
 - 4. Efforts to establish turf and/or sod shall begin as soon as practicable after the vegetative cover layer has been approved by the CQA Manager.

B. In disturbed areas, areas outside of the cap limits that are indicated on the Plans for Construction to be vegetated, and as directed by the CQA Manager, place six (6) inches of vegetative cover in accordance with the specifications above.

3.9. GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Uniformly grade areas to a smooth surface free of irregular surface changes.
 - 3. Always maintain positive drainage.
 - 4. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

3.10. SOIL MOISTURE CONTROL

- A. Moisture Adjustment: Moisture content shall be adjusted as necessary to facilitate compaction and minimize for dusting. Moisture control shall be achieved by either windrowing or adding water to achieve workable moisture content.
- B. Water may be added to the material at the source or after the material has been brought into its final position, whichever is more practical. When material deposited is too dry, the Contractor shall water each layer and obtain uniform moisture distribution in the layer by disking, blading, or other approved methods. The amount of water applied shall be controlled so that free water will not appear on the surface during or subsequent to compaction operations.
- C. Material deposited on the fill that is too wet shall be removed or spread and permitted to dry, assisted by disking or blading, if necessary, until the moisture content is reduced to the specified limits.
- D. When the top surface of a layer becomes too dry or too smooth to permit suitable bonding with the subsequent layer, the Contractor shall loosen the material by scarifying or disking. The Contractor shall then moisten the loosened material to acceptable moisture content and recompact the material to the specified density.

3.11. COMPACTION REQUIREMENTS

- A. Lift thickness: Refer to the paragraphs above for the maximum loose lift thicknesses for various applications and materials. For material compacted by hand-operated tampers, lift thickness shall not exceed four (4) inches in loose depth.
- B. Compact fill materials to not less than the following percentages of standard Proctor maximum dry unit weight, as determined from ASTM D698:
 - 1. Clay Cap: Compact each layer of material to at least 95 percent and within the established permeability window after compaction.
 - 2. Vegetative Cover: Compact by fully tracking over the entire lift.

- C. CQA Requirements:
 - 1. Field conformance testing shall include periodic in-place density and device calibration testing to provide documentation of the compaction operations at prescribed intervals provided in the testing schedule presented in the CQA Plan.
- D. Soil Fill:
 - 1. Compacted soil fill will be subject to the testing schedule noted in the CQA Plan.
 - 2. Following initial compaction, the surface shall be sealed with a smooth drum roller to reduce the potential for surface water infiltration.

3.12. ROADWAYS

- A. Crushed stone for the dike access road shall not be placed until the clay cap has been approved by the CQA Manager.
- B. Construction access roadways shall be comprised of crushed stone materials or equivalent approved by CQA Manager and constructed at locations, dimension, and elevations as required by the Contractor to complete the work shown on the Plans for Construction.
 - 1. Contractor shall obtain approval for locations, dimensions, and elevations of construction access roads from CQA Manager and Owner prior to constructing construction access roads.
- C. Contractor shall be responsible to maintain roadways in good condition throughout construction so that the Owner can continue to use them for future work at the site.
- D. Roadways shall be constructed and maintained so as not to impede site drainage.
- E. Erosion and sediment control measures shall be required in association with the roadways at the discretion of the CQA Manager or Owner. The costs shall be incidental to the roadway construction.

3.13. DUST CONTROL

The Contractor shall control fugitive dust emissions in accordance with Section 31 25 00 – Erosion Protection and Sediment Control.

3.14. DISPOSAL OF SURPLUS AND WASTE MATERIAL

- A. Contractor shall remove cleared vegetation and other waste materials from the Owner's property and legally dispose at a permitted off-site disposal location in accordance with Section 31 10 00 – Site Clearing.
 - 1. Contractor is responsible for identifying a permitted, off-site disposal location for the disposal of waste material.

3.15. FIELD QUALITY CONTROL

Quality control material testing and construction observation will be performed in accordance with the CQA Plan.

3.16. REPAIRS

Remove, replace, or re-work materials and/or grades that do not comply with requirements of the Plans for Construction or the Specifications.

END OF SECTION 31 20 00

TECHNICAL SPECIFICATIONS

DIVISION 31 – EARTHWORK

SECTION 31 25 00 – EROSION AND SEDIMENT CONTROLS

PART 1 - GENERAL

1.1. DESCRIPTION OF WORK

This Section includes provisions for erosion and sediment control and stabilization. All construction activities shall be conducted in accordance with applicable environmental requirements. Erosion and sediment control measures shall be installed prior to disturbance where applicable.

1.2. RELATED DOCUMENTS

- A. The conditions and description of Work shown in other sections of these Specifications, the Plans for Construction, the Construction Quality Assurance (CQA) Plan, and the Storm Water Pollution Prevention Plan (SWPPP) apply to this Section.
- B. The Tennessee Erosion and Sediment Control Handbook (latest edition) applies to this Section.
- C. Related Sections:
 - 1. Section 01 22 00 Special Provisions

1.3. SUMMARY

- A. This section includes the following:
 - 1. Construction phase operations.
 - 2. Erosion and sediment control features.

1.4. CODES AND STANDARDS

- A. The following codes, specifications, and standards (latest editions) of the American Society of Testing and Materials (ASTM) shall apply:
 - 1. ASTM D3786, "Standard Test Method for Bursting Strength of Textile Fabrics—Diaphragm Bursting Strength Tester Method."
 - 2. ASTM D4355, "Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc Type Apparatus."
 - 3. ASTM D4491, "Standard Test Methods for Water Permeability of Geotextiles by Permittivity."
 - 4. ASTM D4533, "Standard Test Method for Trapezoid Tearing Strength of Geotextiles."
 - 5. ASTM D4632, "Standard Test Method for Grab Breaking Load and Elongation of Geotextiles."

- 6. ASTM D4751, "Standard Test Method for Determining Apparent Opening Size of a Geotextile."
- 7. ASTM D4833, "Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products"
- 8. ASTM G26, "Practices for Operating Light-Exposure Apparatus (Xenon-Arc Type) With and Without Water Exposure for Nonmetalic Materials."
- B. The following codes, specifications, and standards (latest editions) of the Tennessee Department of Environment and Conservation (TDEC) shall apply:
 - 1. TDEC, "Tennessee Erosion and Sediment Control Handbook."

1.5. SUBMITTALS

- A. Submittals shall be provided by each supplier for each product to show conformance to these Specifications and the Plans for Construction. Submittals shall be provided to the CQA Manager at least ten (10) working days prior to the installation of products.
- B. Product Data:
 - 1. Certifications statements shall be provided by each material supplier indicating that the products conform to these Specifications:
 - a. Silt fence with wire backing.
 - b. Silt control rock bags.

PART 2 - PRODUCTS

2.1. SILT FENCE WITH WIRE BACKING

- A. Silt fence shall be provided as shown on the Plans for Construction.
- B. Silt Fence Posts: T-type steel post, min. 1.25 lb./ft., with projections for fastening the geotextile fabric.
- C. Geotextile Fabric: Geotextile fabric for silt fence shall meet the requirements shown in Table 1.

Property	Test Method	Value
Geotextile Fabric Type		Woven monofilament
Apparent Opening Size	ASTM D4751	#70 to #100 standard sieve
Water Flux	ASTM D4491	≥ 18 gpm/ft ²
Tensile Strength	ASTM D4632	≥ 310 lb. (warp direction) 200 lb. (fill direction)
UV Stability (after 500 hours)	ASTM D4355	≥ 90%
Burst Strength	ASTM D3786	≥ 400 psi
Puncture Strength	ASTM D4833	≥ 105 lbs
Trapezoidal Tear	ASTM D4533	≥ 100 lbs (warp direction) 60 lbs (fill direction)

Table 1: Requirements for Silt Fence Geotextile Fabric

2.2. SILT CONTROL ROCK BAGS

Silt control rock bags shall be provided as shown on the Plans for Construction.

PART 3 - EXECUTION

3.1. CONSTRUCTION PHASE OPERATIONS

- A. The Contractor shall evaluate the progress of work on the project and determine phasing of work. Erosion and sediment control measures shall be in place to the extent practicable prior to commencement of excavation or embankment activities in a discrete area.
 - 1. Perform excavation or grading in such a manner as to route sediment-laden runoff through installed sediment control measures. Excavate and place fill material during dry weather, when possible.
 - 2. Establish final grade in a given area as quickly as practical in order to allow application of protective measures.
- B. The Contractor shall control fugitive dust emissions.
 - 1. Control dust generation on roads by wetting haul roads or by applying approved (by TVA Environmental) chemical soil binders, as needed.
 - 2. Control dust generation on graded areas that will not be disturbed again for 14 days or more by spraying with Flexterra or equivalent hydromulch approved by the CQA Manager at a rate of 2,000 pounds per acre. For lesser periods of time, spray with water.
- C. The Contractor shall not discharge raw silt and sediment laden water from the site without providing for removal of soil particles.
 - 1. Use silt fencing and/or silt control rock bags as pretreatment areas to avoid siltation of the ditches.

- 2. Inspections of Best Management Practices shall be performed in accordance with the SWPPP.
- 3. The Contractor shall maintain all best management devices by removing accumulated silt, repairing or replacing damaged devices, and by cleaning up any excess discharges or mud on gravel roads.

3.2. SEDIMENT BARRIERS

- A. At a minimum, the Contractor shall install silt fences and silt control rock bags as shown on the Plans. Sediment barriers may also be required at additional locations such as along the contour above benches, at the toe of the slopes, and along ditches. Site and weather conditions may dictate the need for the additional placement.
- B. Maintenance: Inspect silt fences and silt control rock bags in accordance with the SWPPP. Remove sediment before it reaches one-half the height of the silt fence. Reinstall sections of fence which have washed out underneath the fence. Replace broken, torn, or worn silt fences. Rebuild or replace damaged silt control rock bags. Make repairs within three (3) days of discovery.

3.3. INSPECTION AND MAINTENANCE

- A. Inspect slopes for erosion in accordance with the SWPPP. Repair gullied areas and any upslope areas contributing large volumes of sediment. Install berms, fiber coils, or other measures as needed. Remove sediment from sediment control devices as discussed in section 3.2.
- B. Inspect equipment and hydraulic oil systems at the beginning of each day. Repair or replace frayed or damaged lines or hoses before use in or near water and provide containment measures, if required.
- C. Keep erosion and sediment controls in good working order until the project is completed. Brush and other debris should be removed from work areas. Sediment accumulating behind silt fences or other sediment filters should be removed regularly. All structures that have become dislodged or damaged (such as silt fences, etc.) should be repaired as soon as practicable in accordance with the SWPPP.
- D. Make sure that waste materials, building materials, and supplies are properly tied down or contained so that wind and storm water runoff cannot carry the materials away. Fuel, lubricants, and hazardous waste products should be stored in an approved tank or other structure to avoid spills and runoff. Provide spill kits and containment material on-site, especially near fueling or equipment service areas. Maintain vehicles and equipment away from the site if possible. If maintenance must occur on-site, ensure that spills are cleaned up quickly.

END OF SECTION 31 25 00

TECHNICAL SPECIFICATIONS DIVISION 31 – EARTHWORK SECTION 31 40 00 – GEOTEXTILE AND GEOCOMPOSITE

PART 1 - GENERAL

1.1. DESCRIPTION OF WORK

This Specification covers geotextile fabric and geocomposite drainage media (geocomposite) that will be used for separation and cushion applications. The Work for this Section includes furnishing all labor, materials, and equipment to complete installation of geotextile fabric and geocomposite, including all necessary and incidental items, in accordance with the Plans for Construction and Specifications.

1.2. RELATED DOCUMENTS

- A. The conditions and description of Work shown in other sections of these Specifications, the Plans for Construction, the Construction Quality Assurance (CQA) Plan, and the Storm Water Pollution Prevention Plan (SWPPP) apply to this Section.
- A. Geotextile fabric installed in relation to erosion and sediment control measures such as silt fence shall meet the requirements outlined in Section 31 25 00 Erosion and Sediment Controls.
- B. Related Sections
 - 1. Section 01 22 00 Special Provisions
 - 2. Section 31 20 00 Earth Moving

1.3. SUMMARY

This section includes the following:

Geotextile fabric and geocomposite installation.

1.4. CODES AND STANDARDS

The following codes, specifications, and standards (latest editions) of the American Society of Testing and Materials (ASTM) shall apply:

- 1. ASTM D4355, "Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc Type Apparatus."
- 2. ASTM D4491, "Standard Test Methods for Water Permeability of Geotextiles by Permittivity."
- 3. ASTM D4533, "Standard Test Method for Trapezoid Tearing Strength of Geotextiles."
- 4. ASTM D4632, "Standard Test Method for Grab Breaking Load and Elongation of Geotextiles."

- 5. ASTM D4751, "Standard Test Method for Determining Apparent Opening Size of a Geotextile."
- 6. ASTM D6193, "Standard Practice for Stitches and Seams."
- 7. ASTM D6241, "Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe."

1.5. SUBMITTALS

A. Geotextile Fabric: The Contractor shall submit the following to the CQA Manager at least ten (10) working days prior to the installation of geotextile fabric:

Certification statements provided by each material supplier indicating that the geotextile fabric conforms to these Specifications.

- B. Geocomposite: The Contractor shall submit a statement to the CQA Manager that the Ownerprovided geocomposite will be used in lieu of the 16 ounce non-woven geotextile cushion.
 - 1. The Installer shall furnish a Panel Orientation Plan to the CQA Manager at least ten (10) working days prior to installation of the geocomposite material. The Plan shall show the proposed panel layout and shall include seaming details.
 - 2. The Installer shall submit complete records, including red line drawings, on all repairs, overlap locations, and panel placement.
- C. The Contractor shall furnish samples for shear box test to the CQA Manager at least four (4) weeks prior to shipment.

1. Sample size to be specified by the CQA Manager.

1.6. DELIVERY, STORAGE, AND HANDLING

- A. Rolls of geotextile fabric shall be prepared to ship by appropriate means to prevent damage to the material and to facilitate off-loading.
- B. Material certifications shall be provided on the shipped material.
- C. Materials shall be handled so as to prevent damage.
- D. On-Site Storage:
 - 1. Geotextile Fabric: Shall be protected from direct sunlight, ultra-violet rays, temperature greater than 140 degrees Fahrenheit, mud, dirt, dust, and debris during shipment and storage. To the extent possible, the geotextile shall be maintained wrapped in a heavy duty protective covering.
 - 2. Geocomposite: Storage location will be provided by the Owner. The Installer shall be responsible for preparing the storage area in such a manner as to protect the geocomposite from punctures, abrasions, and excessive dirt and moisture. The storage area shall have the following characteristics:
 - a. Level (No wooden pallets)

- b. Smooth
- c. Dry
- d. Protected from UV exposure
- e. Protected from theft and vandalism

PART 2 - PRODUCTS

2.1. GEOTEXTILE FABRIC FOR SEPARATION APPLICATION

- A. Material: Non-woven polyester or polypropylene fabric.
- B. Geotextile fabric at transitions from soil to stone shall meet the requirements shown in Table 1.

Table 1: Requirements for Geotextile Fabric for Separation Application

Property	Test Method	Value
Grab Tensile Strength	ASTM D4632	205 lbs. (min.)
Elongation at Failure	ASTM D4632	<50%
Trapezoid Tear Strength	ASTM D4533	80 lbs. (min.)
CBR Puncture Strength	ASTM D6241	500 lbs. (min.)
Permittivity	ASTM D4491	1.4 sec ⁻¹ (min.)
Apparent Opening Size	ASTM D4751	No. 80 U.S. Sieve
UV Resistance (at 500 hours)	ASTM D4355	70% strength retained (min.)
Fabric Weight		8 oz./SY (min.)

2.2. GEOTEXTILE FABRIC FOR CUSHION APPLICATION

- A. Material: Non-woven polyester or polypropylene fabric.
- B. Geotextile fabric installed immediately above and beneath the geomembrane shall meet the requirements shown in Table 2.

Table 2: Requirements for Geotextile Fabric for Cushion Application

Property	Test Method	Value
Grab Tensile Strength	ASTM D4632	425 lbs. (min.)
Elongation at Failure	ASTM D4632	<50%
Trapezoid Tear Strength	ASTM D4533	150 lbs. (min.)
CBR Puncture Strength	ASTM D6241	1,200 lbs. (min.)
Permittivity	ASTM D4491	0.57 sec ⁻¹ (min.)
Apparent Opening Size	ASTM D4751	No. 100 U.S. Sieve
UV Resistance (at 500 hours)	ASTM D4355	70% strength retained (min.)
Fabric weight		16 oz./SY (min.)

2.3. GEOCOMPOSITE

- A. Geocomposite may be used in lieu of geotextile fabric for cushion application.
- B. Geocomposite shall be Skaps TN 270-2-6 or approved equal.

PART 3 - EXECUTION

3.1. INSTALLATION

- A. General: If geocomposite is used in lieu of the geotextile fabric for cushion application, the Contractor shall deploy the geocomposite in accordance with the Manufacturer's recommendations.
- B. The Contractor shall adhere to the Manufacturer's recommendations and these Specifications during installation of geotextile fabric.
- C. Geotextile fabric and geocomposite shall be rejected if they have defects, rips, holes, flaws, deterioration, or damage incurred during manufacture, transportation, storage, handling, or installation.
- D. The surface to receive geotextile fabric shall be prepared to a relatively smooth condition free of obstructions, depressions, debris, and soft or low density pockets of material.
- E. The geotextile shall be placed with the long dimension parallel with the centerline of the trench and shall be laid smooth and free of tension, stress, folds, wrinkles, or creases.
- F. Geotextile Seams:
 - On slopes 3(H):1(V) and steeper: Adjacent strips of geotextile shall be joined by stitching together continuously. All stitches shall be Federal Stitch Type 401 (ASTM D6193) with a minimum of five (5) stitches per inch. Thread used in sewing shall be the same material as the geotextile. All seam strengths shall be equal to or greater than 90 percent of the grab tensile strength of the geotextile or reinforcing fabric as determined by ASTM D4632.
 - On slopes less than 3(H):1(V): Overlapping in the slope direction may be used. Overlaps, if used, shall be a minimum of two (2) feet. No allowance for overlap will be made in measurement and payment.
- G. Geocomposite Seams:
 - 1. The geocomposite panels shall be overlapped and seamed together in accordance with the Manufacturer's recommendations.

3.2. PROTECTION FROM DAMAGE

- A. The geotextile fabric and reinforcing fabric shall be protected at all times during construction from contamination by surface runoff.
- B. The Work shall be scheduled so that the covering of the geotextile fabric with a layer of the specified material is accomplished within seven (7) days after placement of the geotextile fabric.

- C. The geotextile fabric shall be protected from damage by limiting the drop height of material placed on the geotextile fabric, installing cushion layers, and any other means acceptable to the CQA Manager. Before placement of material, the Contractor shall demonstrate to the CQA Manager, using field tests, that the placement technique will prevent damage.
- D. Any damage during installation or placement of materials, or failure to cover geotextile within the specified time, shall warrant removal and replacement of the geotextile by the Contractor at no additional cost to the Owner.
- E. In applying fill material, no equipment can drive directly across geocomposite. The specified fill material shall be placed and spread utilizing vehicles with a low ground pressure (LGP). The LGP equipment shall have a ground pressure of 6 psi or less. The cover shall be placed on the geocomposite from the bottom of the slope proceeding upwards and in a manner which prevents instability of the cover material or damage to the geocomposite. Placement of the cover material shall proceed immediately following placement and inspection of the geocomposite. Geocomposite material shall not be exposed to ultra violet light for more than 15 days.
- F. The installed geomembrane and geocomposite shall be protected from damage during construction and general operations. Under no condition shall vehicles or heavy equipment (other than LGP dozer) drive over the geocomposite without a minimum 6 inches of cover material in place.

3.3. REPAIRS

Prior to covering the deployed geotextile fabric or geocomposite, each panel shall be inspected for damage resulting from construction. Any rips, tears, or damaged areas shall be removed and patched in accordance with the Manufacturer's recommendations.

END OF SECTION 31 40 00

TECHNICAL SPECIFICATIONS DIVISION 32 – EXTERIOR IMPROVEMENTS SECTION 32 31 13 – CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1. DESCRIPTION OF WORK

This Specification covers the galvanized steel, industrial chain link fence and swing gate that will be used as a component of the Project as defined below. The Work for this section consists of furnishing all labor, material, and equipment to complete installation of the fence and swing gate, including all necessary and incidental items, in accordance with the Plans for Construction and Specifications.

1.2. RELATED DOCUMENTS

- A. The conditions and description of Work shown in other sections of these Specifications, the Plans for Construction, and the Construction Quality Assurance (CQA) Plan apply to this Section.
- B. Related Sections:
 - 1. Section 01 22 00 Special Provisions
 - 2. Section 31 20 00 Earth Moving
 - 3. Section 31 25 00 Erosion and Sediment Controls

1.3. SUMMARY

- A. This Section includes the following:
 - 1. Chain link fence.
 - 2. Swing gate.

1.4. CODES AND STANDARDS

- A. The following codes, specifications, and standards (latest editions) of the American Society of Testing and Materials (ASTM) shall apply:
 - 1. ASTM A121, "Standard Specification for Metallic-Coated Carbon Steel Barbed Wire."
 - 2. ASTM A123, "Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products."
 - 3. ASTM A392, "Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric."
 - 4. ASTM A780, "Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings."

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- 5. ASTM A824, "Standard Specification for Metallic-Coated Steel Marcelled Tension Wire for Use With Chain Link Fence."
- 6. ASTM C33, "Standard Specification for Concrete Aggregates."
- 7. ASTM F567, "Standard Practice for Installation of Chain Link Fence."
- 8. ASTM F626, "Standard Specification for Fence Fittings."
- 9. ASTM F883, "Standard Performance Specifications for Padlocks."
- 10. ASTM F900, "Standard Specification for Industrial and Commercial Swing Gates."
- 11. ASTM F1043, "Standard Specification for Strength and Protective Coatings on Industrial Fence Framework."
- 12. ASTM F1083, "Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) welded, for Fence Structures."
- B. The following codes, specifications, and standards (latest editions) of the Chain Link Fence Manufacturers Institute (CLFMI) shall apply:
 - 1. CLFMI, "Product Manual."
 - 2. CLFMI, "WLG 2445."

1.5. SUBMITTALS

- A. Submittals shall be provided by each supplier for each product to show conformance to these Specifications and the Plans for Construction. Submittals shall be provided to the CQA Manager at least ten (10) working days prior to the installation of products.
- B. Product Data:
 - 1. Certification statements shall be provided by each material supplier indicating that the products conform to these Specifications:
 - a. Fence and gate posts, rails, and fittings.
 - b. Chain link fabric, reinforcement, and attachments.
 - c. Barbed wire.
 - d. Barbed wire supporting arms.
 - e. Swing gate and hardware.
 - f. Concrete.

- C. Shop Drawings:
 - Shop drawings shall include complete information necessary for fabrication, layout, and installation of chain link fence and swing gate with dimensions, location of gate and opening size, elevation of fence and gate, details of attachments, and details of footings. Contractor shall make all field measurements necessary to verify all dimensions which may affect the installation of chain link fences and gates.
 - 2. Shop drawings are required for the following items:
 - a. Chain link fence assembly and installation.
 - b. Locations of gate, corner, and pull posts.
 - c. Gate assembly.
 - d. Gate hardware and accessories.
- D. Qualification Data: For Installer.

1.6. QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed chain link fences and gates similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Concrete Ready-Mix Delivery Slips: If used, Contractor shall:
 - 1. Keep a record at the job site showing time and place of each batch of concrete, together with ready-mix delivery slips (batch tickets) certifying contents and proportions of each truck load delivered to the site.
 - 2. Make records available to the CQA Manager for his inspection upon request.
 - 3. Upon completion of this portion of the Work, deliver the record and delivery slips to the CQA Manager.
- C. Independent Quality Assurance: Contractor shall accommodate independent quality assurance activities.

1.7. DELIVERY, STORAGE, AND HANDLING

General: Deliver materials to site in an undamaged condition. Store materials off the ground to provide protection against oxidation caused by the ground. Store and handle materials to prevent bending and damage.

1.8. PROJECT CONDITIONS

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

PART 2 - MATERIALS

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 ASTM A392, CLFMI Product Manual, CLFMI WLG 2445, and requirements indicated below:
 - 1. Steel Wire Fabric: Metallic-coated wire with a diameter of 0.192 inch.
 - a. Fabric Height: 84 inches.
 - b. Mesh Size: Two (2) inches
 - c. Weight of Metallic (Zinc) Coating: ASTM A392, Type II, Class 2, 2.0 oz./sq. ft. with zinc coating applied before or after weaving.
 - 2. Selvage: Twisted top and knuckled bottom.

2.2. FENCE FRAMING

- A. Posts and Rails: Comply with ASTM F1043 and the following:
 - 1. Group: IA, round steel pipe, schedule 40.
 - 2. Fence Height: Seven (7) feet.
 - 3. Strength Requirement: Heavy industrial according to ASTM F1043.
 - 4. Post Diameter Thickness: According to ASTM F1083.
 - 5. Post Size and Thickness: According to ASTM F1083.
 - a. Top, Brace, Bottom, and Intermediate Rails: 1.66 inches.
 - b. Line Post: 2.375 inches.
 - c. End, Corner, and Pull Post: 2.875 inches.
 - d. Swing Gate Post: 4-inch diameter, 8.65 lb/ft.
 - 6. Coating for Steel Framing:
 - a. Metallic Coating: Galvanized per ASTM F1083. Exterior and interior zinc coating Type A, consisting of not less than 2.0 oz/sq. ft. average zinc coating per ASTM A123.

2.3. TENSION WIRE

- A. General: Provide horizontal tension wire extending along bottom of fence fabric.
- B. Metallic-Coated Steel Wire: 7 gauge (0.177-inch diameter), marcelled tension wire complying with ASTM A824 and the following:

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- 1. Metallic Coating: Type II, zinc coated (galvanized) by hot-dip processing, with the following minimum coating weight:
 - a. Class 2: Not less than 1.2 oz./sq. ft. of uncoated wire surface.

2.4. SWING GATE

- A. General: Comply with ASTM F900 for single swing gate types.
 - 1. Metal Pipe and Tubing: Galvanized steel. Comply with ASTM F1043 for materials and protective coating.
- B. Frame and Bracing: Fabricate members from round, galvanized steel tubing with outside dimension and weight according to ASTM F900 and the following:
 - 2. Gate Fabric Height: Two (2) inches less than adjacent fence height. Provide same type as used in fence construction.
 - 3. Leaf Width: Forty-eight (48) inches. Shall be measured from inside face to inside face of gate posts.
 - 4. Frame Members:
 - a. Tubular Steel: 1.90 inches round.
- C. Frame Corner Construction: Welded or assembled with corner fittings and 5/16-inch-diameter adjustable truss roads.
- D. Extended Gate Posts and Frame Members: Extend gate posts and frame end members above top of chain link fence at both ends of gate no less than twelve (12) inches above top of chain link fabric at both ends of gate frame as required to attached barbed wire assemblies.
- E. Hardware:
 - 1. Gate Hinges: Structurally capable of supporting the gate leaf and allow the gate to open and close without binding. Shall be designed to permit the gate to swing a full 180 degrees.
 - 2. Latch: Capable of retaining gate in closed position and shall have a provision for a padlock accessible from both sides of gate.
 - 3. Padlocks and chain: Provide padlocks and chain conforming to ASTM F883.

2.5. FITTINGS

- A. General: Comply with ASTM F626.
- B. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz./sq. ft. zinc.
- C. Post and Line Caps: Provide for each post.
 - 1. Line post caps with loop to receive top rail.

- D. Rail and Brace Ends: Attach rails securely to each gate, corner, pull, and end post.
- E. Rail Fittings: Provide the following:
 - 1. Top and Bottom Rail Sleeves: Pressed-steel or round-steel tubing not less than six (6) inches long.
- F. Tension and Brace Bands: Galvanized pressed steel with minimum thickness of 12 gauge (0.105 inch), minimum width of 3/4 inch. Bands supplied with 3/8 inch galvanized steel carriage bolts.
- G. Tension Bars: Galvanized steel, length not less than two (2) inches shorter than the full height of the chain link fabric. Shall have a minimum cross section of 3/16 inch by 3/4 inch. Provide one (1) bar for each gate and end post, and two (2) for each corner and pull post.
- H. Truss Road Assemblies: Steel, hot-dip galvanized after threading rod and turnbuckle or other means of adjustment.
- I. Barbed Wire Arms: Pressed-steel or cast iron with clips, slots, or other means for attached strands of barbed wire, integral with post cap; for each post, unless otherwise indicated, and as follows:
 - 1. Line posts with arms that accommodate top rail.
 - 2. Corner arms at fence corner posts, unless extended posts are indicated.
 - 3. Type I, single-slanted arm.
- J. Tie Wires, Hog Rings, Clips, and Fasteners: According to ASTM F626.
 - 1. Standard Round Wire Tires: For attaching chain link fabric to posts, rails, and frames, complying with the following:
 - a. Hot-Dip Galvanized Steel: 9 gauge (0.148-inch diameter) wire; galvanized coating thickness matching coating thickness of chain link fence fabric.
 - 2. Hog Rings: For attaching chain link fabric to tension wire, complying with the following:
 - a. Hot-Dip Galvanized Steel: 9 gauge (0.148-inch diameter) wire; galvanized coating thickness matching coating thickness of chain link fence fabric.

2.6. BARBED WIRE

- A. Zinc-Coated Steel Barbed Wire: Comply with ASTM A121, Chain Link Fence Grade for the following two-strand barbed wire:
 - 1. Standard Size and Construction: 12-1/2 gauge (0.099-inch diameter) twisted strand wire with 14 gauge (0.080-inch diameter), 4-point barbs spaced not more than five (5) inches on center.
 - a. Coating Type Z Zinc-Coated: Strand wire coating type Z, Class 3, 0.80 oz./sq. ft. zinc, barb coating 0.70 oz./sq. ft.

2.7. CONCRETE

Concrete to backfill fence post holes shall be TDOT Class A, or a mix that meets the following: Normal-weight concrete with not less than 3,000 psi compressive strength at twenty-eight (28) days, three-inch (3-inch) slump, and one-inch (1-inch) maximum size aggregate.

PART 3 - EXECUTION

3.1. SITE PREPARATION

- A. Clear fence line of trees, brush, and other obstacles to install fencing. Establish a graded, compacted fence line prior to installation.
- B. Stake locations of fence lines, gates, and terminal posts. Indicate locations of utilities, underground structures, benchmarks, and property monuments.
- C. Protect existing site improvements to prevent damage during construction. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2. CHAIN LINK FENCE INSTALLATION

- A. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil or compacted crushed stone.
- B. Post Settings: Set posts in concrete at indicated spacing into firm, undisturbed soil or compacted crushed stone.
 - 1. Verify that posts are set plumb, aligned, and 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. Exposed Concrete: Extend two (2) inches above grade, shape and smooth to shed water.
- C. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F567 and terminal pull posts at changes in horizontal or vertical alignment of fifteen (15) degrees or more.
- D. Line Posts: Space line post uniformly at no greater than ten (10) feet on center.
- E. Post Bracing and Intermediate Rails: Install according to ASTM F567, maintaining plumb position and alignment of fencing. Install braces at end and gate posts and at both sides of corner and pull posts.
 - 1. Locate horizontal braces at midheight of fabric or higher. Install so posts are plumb when diagonal rod is under proper tension.
- F. Tension Wire: Install according to ASTM F567, maintaining plumb position and alignment of fencing. Pull wire taut, without sags. Fasten fabric to tension wire with hog rings, spaced a maximum of eighteen (18) inches on center. Install tension wire in locations indicated before stretching fabric.

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- 1. Bottom Tension Wire: Install bottom tension wire within six (6) inches of bottom of fabric.
- G. Top Rail: Install according to ASTM F567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps or barbed wire arm loops, terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended by fencing manufacturer.
- H. Bottom Rail: Install, spanning between posts, in locations indicated on the Plans for Construction.
- Chain Link Fabric: Apply fabric to outside of enclosing framework. Leave a maximum of two (2) inches between finish grade or surface and bottom selvage. Pull fabric taunt and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.
- J. Tension Bars: Thread through chain link fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than twelve (12) inches on center.
- K. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end chain link fabric, wrap wire around post a minimum of 180 degrees, and attached other end to chain link fabric per ASTM F626. Bend ends of wire to minimize hazard to individuals and clothing.
 - 1. Maximum Spacing: Tie fabric to line posts at not more than twelve (12) inches on center and rails and braces at not more than eighteen (18) inches on center.
- L. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side.

3.3. GATE INSTALLATION

- A. Install gate 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.
 - 1. The maximum hinge and latch offset opening space from gate frame to posts shall be three (3) inches.

3.4. BARBED WIRE

Install single sloped arms, sloped to away from the area enclosed by the fence, as recommended by the manufacturer. Stretch three (3) strings of barbed wire taut between terminal posts and secure in slots on line arms. Attach each strand of barbed wire to terminal post with brace band.

3.5. PADLOCKS

Provide padlocks for gate openings and provide chains that are securely attached to gate or gate posts. Provide padlocks keyed alike and provide two (2) keys to the Owner for each padlock.

3.6. ZINC-COATING REPAIR

Clean and repair galvanized surface damaged by welding, abrasion, or cutting in accordance with ASTM A780.

3.7. INSTALLATION TOLERANCES

- A. Maximum Variation from Plumb: 1/4 inch in ten (10) feet.
- B. Maximum Offset from True Position: 1/2 inch from the established centerline between posts.

END OF SECTION 32 31 13

TECHNICAL SPECIFICATIONS DIVISION 32 – EXTERIOR IMPROVEMENTS SECTION 32 92 00 – TURF AND GRASSES

PART 1 - GENERAL

1.1. DESCRIPTION OF WORK

This Specification covers the long term stabilization of the site. The Work for this Section includes furnishing all labor, materials, and equipment for preparing the vegetative cover, adding soil amendments, and sodding disturbed areas, including all necessary and incidental items, in accordance with the Plans for Construction and Specifications.

1.2. RELATED DOCUMENTS

- A. The conditions and description of Work shown in other sections of these Specifications, the Plans for Construction, the Construction Quality Assurance (CQA) Plan, and the Storm Water Pollution Prevention Plan (SWPPP) apply to this Section.
- B. Related Sections:
 - 1. Section 01 22 00 Special Provisions
 - 2. Section 31 10 00 Site Clearing
 - 3. Section 31 20 00 Earth Moving
 - 4. Section 31 25 00 Erosion and Sediment Controls

1.3. SUMMARY

- A. This section includes the following:
 - 1. Vegetative cover preparation.
 - 2. Soil amendments.
 - 3. Sodding.

1.4. CODES AND STANDARDS

- A. The following codes, specifications, and standards (latest editions) shall apply:
 - 1. Tennessee Department of Transportation (TDOT), "Standard Specifications for Road and Bridge Construction (Standard Specifications)," Section 803.
 - 2. Turfgrass Producers International (TPI), "Guidelines Specifications to Turfgrass Sodding."

1.5. DEFINITIONS

- A. Finish Grade: Elevation of finished surface of planting soil.
- B. Installer: A party responsible for the establishment of sod.
- C. Subgrade: Surface or elevation of subsoil remaining after excavation is complete or top surface of a fill or backfill before vegetative cover is placed.
- D. Subsoil: All soil beneath the vegetative cover layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- E. Vegetative Cover: Top layer of the soil profile where plant roots grow.

1.6. SUBMITTALS

- A. The Contractor shall submit the following to the CQA Manager at least ten (10) working days prior to installation or usage to show conformance to these Specifications and the Plans for Construction:
 - 1. Product Data:
 - a. Sod: Certification of each seed mixture for turfgrass sod. Include identification of source and name and telephone number of supplier.
 - b. Soil Amendments: Product data sheet for each soil amendment. Include identification of source and name and telephone number of supplier. Include certification that soil amendment is approved by the Tennessee Department of Agriculture.
 - c. Fertilizer: Certification and CaCO3 equivalency certification.
 - 2. Agronomic soil tests results.
 - 3. Qualification Data: For qualified landscape Installer.
 - 4. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of turf during a calendar year.

1.7. QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful turf establishment.
 - 1. Experience: Minimum of three (3) years of experience in turf installation.
 - 2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
- B. Fertilizer (bagged or bulk), either dry or liquid, must be manufactured and sold under the jurisdiction of the Tennessee Department of Agriculture.

C. Agricultural limestone shall be purchased from quarries approved by the Tennessee Department of Agriculture.

1.8. DELIVERY, STORAGE, AND HANDLING

- A. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Transplanting and Installation" in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage and drying.
- B. Bulk Materials:
 - 1. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.
 - 2. Do not dump or store bulk materials near structures, utilities, or roadways or on existing turf areas.
 - 3. Provide erosion control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, or airborne dust reaching adjacent properties, water conveyance systems, or walkways.
- C. Handling: Do not drop or dump materials from vehicles.

1.9. PROJECT CONDITIONS

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. Do not plant when the ground is frozen, snow covered, or muddy or when air temperature exceeds 90 degrees Fahrenheit.

1.10. MAINTENANCE SERVICE

Initial Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, as determined by the CQA Manager, but for not less than 30 days from date of planting completion.

PART 2 - PRODUCTS

2.1. TURFGRASS SOD

A. Sod shall be selected to meet the requirements of Section 803 of the TDOT Standard Specifications.

2.2. LIME

A. Agricultural ground limestone or its equivalent shall be used. Ground limestone shall meet the following requirements:

- 1. Contain sufficient calcium and magnesium carbonate and be equivalent to not less than 80 percent calcium carbonate.
- 2. Graded such that not less than 90 percent passes through a U.S. Standard No. 10 sieve and not less than 35 percent passes through a U.S. Standard No. 50 sieve.
- 3. Purchased from quarries approved by the Tennessee Department of Agriculture.

2.3. FERTILIZER

- A. Fertilizer shall be a commercial fertilizer containing the plant nutrients of nitrogen (N), available phosphoric acid (P2O5), and soluble potash (K2O). The fertilizer utilized shall be 19-19-19 or equivalent.
- B. Bagged fertilizer shall display the following information on the bag or on a sticker or tag attached to the bag:
 - 1. Net weight.
 - 2. Brand and grade.
 - 3. Guaranteed analysis.
 - 4. Name and address of manufacturer.
- C. Bulk fertilizer (dry or liquid) shall be accompanied by a statement from the manufacturer which contains the same information required for the bagged fertilizer.

2.4. COMPOST

- A. Compost shall consist of organic matter such as Buffalo Compost or equivalent.
- B. The compost shall be free of deleterious amounts of metals, pesticides, or other environmental hazards.
- C. The compost shall be capable of being spread and incorporated into the soil or mixed with hydraulic mulch.
- D. Alternate composts that introduce organic matter will be considered.

PART 3 - EXECUTION

3.1. EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting performance:
 - 1. Verify that no foreign or deleterious material has been deposited in soil within a planting area.
 - 2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.

- 3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
- 4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.
- B. If contamination by foreign or deleterious material is present in soil within a planting area, remove the soil and contamination as directed by CQA Manager and replace with new planting soil.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2. **PREPARATION**

Protect structures, utilities, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

3.3. TURF AREA PREPARATION

- A. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus one (1) inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.
- B. The areas to be vegetated shall be dressed to a reasonably smooth, firm surface, as determined by the CQA Manager. Compost, where needed to add organic content, shall be incorporated into the top four (4) inches of soil by disking or tilling.
- C. Lime shall be applied at the rate determined by soil (nutrient) testing, performed by the Contractor, taken at a minimum of one (1) test per ten (10) acres of vegetative cover area. Fertilizer shall be applied at a rate sufficient to meet the requirements of nitrogen (N), phosphorus (P2O5), and potash (K2O) indicated by soil testing performed immediately prior to installing sod. These soil tests shall be the responsibility of the Contractor.
- D. Loosen the vegetative cover to a depth of four (4) inches. Remove stones larger than three (3) inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
- E. Preparation shall be suspended when soil conditions are not suitable for installing sod. The CQA Manager shall make this determination.
- F. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- G. Before planting, obtain CQA Manager's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4. SODDING

- A. Lay sod within 36 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.
- B. Lay sod to form a mass with tightly fitted joints. Butt ends and sides of sod; do no stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade,

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 angle of slopes exceeding 4(H):1(V).
- 2. Anchor sod on slopes exceeding 4(H):1(V) with wood pegs or steel staples spaced as recommended by sod manufacturer but not less than one (1) anchor per four (4) feet per edge of sod strip.
- C. Saturate sod with fine water spray within two (2) hours of planting. Water once daily or more frequently as necessary during the first week after laying sod to maintain moist soil to a minimum depth of 1-1/2 inches below sod.
- D. The Contractor shall be responsible for irrigating the sod as necessary until the end of the maintenance period.
 - 1. The Contractor may construct a temporary irrigation system. The Contractor shall be responsible for all costs associated with materials and labor required to construct a temporary irrigation system.
 - 2. The Contractor shall remove the temporary irrigation system once the CQA Manager determines that satisfactory turf has been established (see paragraph "Satisfactory Turf" below).

3.5. SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by CQA Manager:
 - 1. Satisfactory Turf: A healthy, well-rooted, even colored, viable turf has been established, free of open joints, bare areas, and surface irregularities.
- B. The Contractor shall use specified materials to reestablish turf that does not comply with requirements and continue maintenance and irrigation until turf is satisfactory.

3.6. CLEANUP AND PROTECTION

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.

END OF SECTION 32 92 00